

NEW TAXA AND DISTRIBUTIONAL RECORDS OF AZOOXANTHELLATE SCLERACTINIA (CNIDARIA, ANTHOZOA) FROM THE TROPICAL SOUTH-WEST INDIAN OCEAN, WITH COMMENTS ON THEIR ZOOGEOGRAPHY AND ECOLOGY

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(With 13 figures and 2 tables)

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ABSTRACT

Seventy-seven species of azooxanthellate Scleractinia are reported from collections made by R.V. Anton Bruun, Meiring Naude, and Vityaz from deep-water (to 1 720 m) in the tropical south-west Indian Ocean. Thirty-six new distributional records are noted for this region, increasing the total number of azooxanthellates from 64 to 100—one of the most diverse regions in the world oceans for azooxanthellate Scleractinia. Among the 77 records, seven species (*Caryophyllia elongata*, *Rhizosmilia robusta*, *Sphenotrochus* (S.) *evexicostatus*, S. (S.) *imbricaticostatus*, *Truncatoflabellum gardineri*, *T. zuluense* and *T. multispinosum*) and one subspecies (*Flabellum* (*Ulocyathus*) *japonicum bythios*) are described as new, and four new combinations are proposed.

The distribution and bathymetric ranges of all 100 species are given and zoogeographic affinities discussed. Twelve per cent of the 100 tropical south-west Indian Ocean species are cosmopolitan or widespread in distribution and six per cent were uncategorized. Of the remaining 82 species, the largest distributional pattern is that of Indo-West Pacific (43%), followed by those species known only from the Indian Ocean (36,5%); however, it is believed that, because of the relatively homogeneous nature of the deep-water fauna, there will be a tendency to find an increase of the Indo-West Pacific component at the expense of the Indian Ocean 'endemics' as the deep-water corals become better known. Ten species (12%) co-occur in tropical and southern temperate regions and seven species (8,5%) have a shared distribution with the Atlantic Ocean, five of which are found in the western Atlantic. Three significant bathymetric zones are defined, based on south-west Indian Ocean azooxanthellates: 0–300 m, 300–1 300 m, and 1 300–2 000 m. The potential for using skeletal morphology as an indicator of environmental conditions (i.e. nutrient level) is discussed.

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INTRODUCTION

Our knowledge of the azooxanthellate scleractinian fauna of the tropical south-west Indian Ocean is based on approximately 31 papers (Table 1), most of which include only one or several incidentally collected species or constitute reports on expeditions that briefly entered this region (e.g. *Valdivia*, *John Murray Expedition*, Percy Sladen Trust Expedition). The newly reported specimens presented herein are also based on expeditionary collecting, namely by R.V. *Anton Bruun*, *Vityaz* and the *Meiring Naude*; however, this paper also includes a re-analysis of previously reported specimens and a compilation of all previous records for the region (Table 2). This paper should not be considered as a faunistic revision, but rather as an annotated checklist of those species for which additional specimens were collected.

Sixty-four azooxanthellate Scleractinia have been reported previously from the tropical south-west Indian Ocean (Tables 1, 2). An additional 36 new records (Table 2) for the region are reported herein, resulting in a total of 100 azooxanthellate species for this region. Of the 36 new south-west Indian Ocean records, 11 species are also new records for the Indian Ocean, seven are described as new species, one as a new subspecies, and four new combinations are proposed. Additional records of 77 of the 100 species (77% of the fauna) are presented in the 'Systematic Account'. Examination of an unpublished collection (Zibrowius in prep.) from the same region

TABLE 1

Annotated, chronological list of publications on azooxanthellate Scleractinia from the tropical south-west Indian Ocean (* denotes significant papers).

Year	Author	Remarks
1848 <i>b</i>	Milne Edwards & Haime	Two species of <i>Tubastraea</i> from off Seychelles.
1876	Duncan	<i>Culicia natalensis</i> from off Natal, South Africa.
1902	Gardiner	Two species of <i>Flabellum</i> from South Africa.
*1904	Gardiner	Fifteen azooxanthellate species from off South Africa.
1904	Von Marenzeller	Six deep-water species from <i>Valdivia</i> stations 243-247 off Kenya and Tanzania and other records to north in the Indian Ocean.
1926	Van der Horst	Eight shallow-water, mostly dendrophylliid species collected on Percy Sladen Trust Expedition of 1905 off Zanzibar, Seychelles, Mauritius, and Saya de Malha.
*1927	Van der Horst	Eight shallow-water species, primarily dendrophylliids from off South Africa.
1931	Van der Horst	Seven azooxanthellate species from off Seychelles, Mauritius, and Saya de Malha.
*1938	Gardiner & Waugh	Seventeen deep-water flabellids and caryophylliids collected on the <i>John Murray Expedition</i> (1933-1934) stations 102-133 off Kenya, Tanzania, and Seychelles.

TABLE 1 (cont.)

Year	Author	Remarks
*1939	Gardiner & Waugh	Eleven deep-water dendrophylliids and oculinids collected from the <i>John Murray</i> Expedition (1933-1934) stations 102-133 off Kenya, Tanzania, and Seychelles.
1958	Macnae & Kalk	Uncritical listing of eleven shallow-water azooxanthellates from Inhaca, Mozambique.
1964	Pichon	List of four shallow-water azooxanthellates from Tuléar, Madagascar.
1974a	Zibrowius	Record of <i>Deltocyathus</i> north-west of Madagascar.
1974b	Zibrowius	<i>Javania insignis</i> from off north-west Madagascar.
1974	Pichon	<i>Sphenotrochus</i> sp. from reefs off Madagascar.
1975	Zibrowius, Southward & Day	Polychaete symbionts from three species of <i>Flabellum</i> collected off Natal and Mozambique.
1976	Keller	<i>Fungiacyathus pseudostephanus</i> from off Seychelles and mid-Indian Ridge.
1978	Pichon	Uncritical list of eleven shallow-water azooxanthellates from Tuléar, Madagascar.
1979	Rosen	List of four shallow-water azooxanthellates from off Aldabra.
1979	Cairns	<i>Labyrinthocyathus delicatus</i> from off Natal.
1980	Best, Faure & Pichon	List of six shallow-water azooxanthellates off Seychelles.
1980	Zibrowius	<i>Lophelia pertusa</i> from north-west of Madagascar.
1981	Keller	<i>Caryophyllia scobinosa</i> from off Tanzania.
*1981	Boshoff	Forty-two azooxanthellates reported from off South Africa.
1982	Zibrowius	Two azooxanthellates from off Natal and Madagascar, both hosting crab galls.
1984	Schuhmacher	Discussion of two species of <i>Tubastraea</i> , including records from off Comores and Madagascar.
1985	Zibrowius & Grygier	Nine species of azooxanthellates, all hosting ascothoracid parasites, off Natal, Mozambique, Kenya, Comores, and Seychelles.
1985	Zibrowius	Additional records of <i>Balanophyllia stimpsonii</i> from off Mozambique and Natal, South Africa.
1985	Grygier	Two shallow-water azooxanthellates hosting ascothoracid parasites, from off Kenya, Reunion, and Comores Islands.
1989a	Cairns	Several records of <i>Flabellum pavoninum</i> off Kenya and Durban, South Africa.
1989b	Cairns	Eight species of azooxanthellates discussed incidental to review of Philippine fauna, from off Natal, Mozambique, Tanzania, Kenya, and Reunion.

seen at the Station Marine d'Endoume, Marseille (specimens from *Marion Dufresne*, *Meiring Naude*, *Galathea*, Cruise BENTHEDI on *Le Suroit*, Plante collection) revealed approximately 25 additional azooxanthellate species from this region, which would result in a fauna of about 125 species—one of the most diverse azooxanthellate scleractinian faunas in the world oceans.

Historical resumé. Milne Edwards & Haime (1848b) would appear to have reported the first azooxanthellate scleractinians from the tropical south-west Indian Ocean, *Coenopsammia ehrenbergiana* (= *Tubastraea coccinea*) and *Coenopsammia viridis* (= *Tubastraea micrantha*), from the 'Seychelles', two common, shallow-water species. Another shallow-water species, but less commonly collected, is *Culicia natalensis*, reported by Duncan (1876) from off Natal, South Africa. All of the remaining records of azooxanthellate corals from this region were made in the twentieth century and are summarized in Table 1; only the five most significant contributions are discussed in greater detail. Most of the other references listed in Table 1 are uncritical checklists or concentrate on other geographic areas or topics that only incidentally mention Scleractinia from the south-west Indian Ocean.

The first significant paper on south-west Indian Ocean azooxanthellates was that of Gardiner (1904), who examined over 2 000 specimens collected off South Africa and reported 15 species from this region, including five new species. Although some of his identifications subsequently have been changed, this paper remains the foundation for serious work on azooxanthellate corals from this region. As a counterpart to Gardiner's (1904) contribution, which dealt only with the caryophylliids and flabellids, Van der Horst (1927) reported eight species of dendrophylliids from the same region, based on the same collection sources.

In another pair of papers, Gardiner & Waugh published the results of the Scleractinia collected off Kenya, Tanzania and the Seychelles from the *John Murray* Expedition. Their first paper (Gardiner & Waugh 1938), like Gardiner's (1904), was restricted to the caryophylliids and flabellids; their second (Gardiner & Waugh 1939), like Van der Horst's (1927), reported the dendrophylliids and other minor families. Whereas Gardiner and Van der Horst reported primarily shallow-water azooxanthellates, the Gardiner & Waugh papers reported deeper-water species, their two contributions discussing 28 species collected from *H.E.M.S. Mabihiss* stations 102–133 within the south-west Indian Ocean (Sewell 1935).

Boshoff's (1981) annotated checklist of South African Scleractinia included 42 azooxanthellate species from the south-west Indian Ocean. Unfortunately, none of his specimens were illustrated, his localities are confused and obscure, and many of his identifications are incorrect (Zibrowius & Gili 1990). We are forced to agree with Zibrowius & Gili that Boshoff's contribution is misleading, and we look forward to Zibrowius' revision of the deep-water corals from this region, which will include a re-analysis of all the Boshoff specimens.

Other papers that include useful information on south-west Indian Ocean azooxanthellates, but do not report specimens from this region, include: Wood-Mason & Alcock (1891a, 1891b); Alcock (1893, 1898, 1902c); Bourne (1905); Von Marenzeller (1907a, 1907b); Van der Horst (1922); Gardiner (1929); Wells (1935); Scheer & Pillai (1974, 1983); Pillai & Scheer (1976); Zibrowius (1980); Fricke & Schuhmacher (1983); Zibrowius & Gili (1990); and Sheppard & Sheppard (1991).

ZOOGEOGRAPHY

Of the 100 species of azooxanthellate Scleractinia known from the tropical south-west Indian Ocean, 12 are cosmopolitan or widely distributed (Fig. 1; Table 2: distribution pattern 6) and six are not categorized because they are not identified to the species level or have a disjunct distribution (Table 2: pattern 7), e.g. *Fungiacyathus pseudostephanus*. Neither of these categories contributes to an understanding of zoogeographic affinities.

Of the remaining 82 species, the largest component is the Indo-West Pacific pattern (Table 2: pattern 3), shared by 35 species (43 %). Thirty species (36,5 %) are known only from the Indian Ocean: 20 species (24,5 %, Table 2: pattern 1) thus far

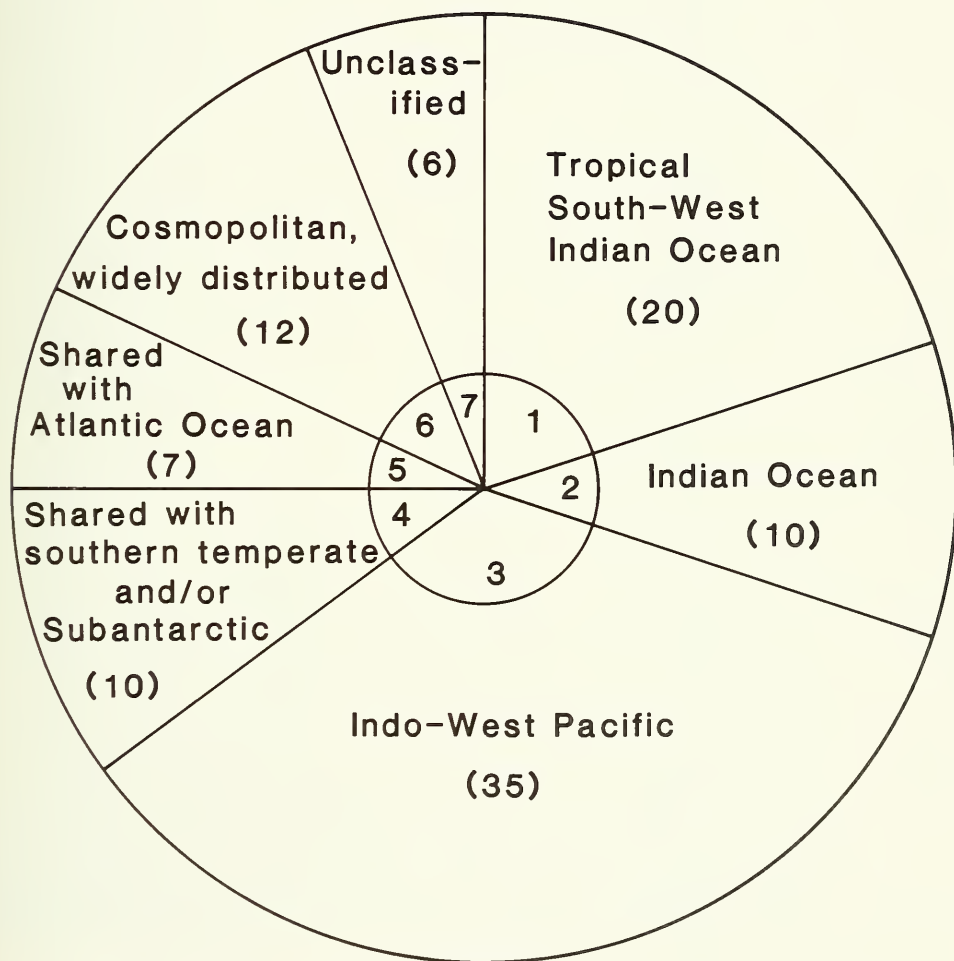


Fig. 1. Pie-diagram illustrating the seven zoogeographic patterns of the 100 species of south-west Indian Ocean azooxanthellate Scleractinia. Numbers in inner circle label the seven zoogeographic patterns discussed in the text and tabulated in Table 2. Numbers in parentheses are the numbers of species having that pattern.

TABLE 2

Checklist and distribution of the tropical south-west Indian Ocean azooxanthellate Scleractinia. (*—new record for South-West Indian Ocean; **—new record for Indian Ocean; —indicates that the species is not in study material and therefore not in Systematic Account. Key to areas: 1 = Western Atlantic; 2 = Eastern Atlantic; 3 = temperate S. Africa; 4 = tropical north-eastern S. Africa; 5 = off Mozambique; 6 = off Tanzania; 7 = off Kenya; 8 = off Madagascar; 9 = islands of South-West Indian Ocean; 10 = Madagascar Plateau; 11 = North-West Indian Ocean; 12 = Eastern Indian Ocean; 13 = Western Pacific; 14 = Western Pacific; 15 = Subantarctic.)

	Atlantic Ocean			South-West Indian Ocean					Indian Ocean			Pacific Ocean			Subantarctic	Distribution ¹	Depth (m) (Indian Ocean)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Family Pocilloporidae																	
<i>Madracis</i> sp. A					X	?		?		X	?					7	42-160
Family Fungiacyathidae																	
* <i>Fungiacyathus</i> (<i>B.</i>) <i>pseudostephanus</i> Keller, 1976									X					X		7	3 880-5 120
<i>Fungiacyathus</i> (<i>B.</i>) <i>sibogae</i> (Alcock, 1902)				X	X	X	X	X			X		X			3	463-1 948
<i>Fungiacyathus</i> (<i>F.</i>) <i>stephanus</i> (Alcock, 1893)				X	X					X	X	X				3	880-2 000
<i>Fungiacyathus</i> (<i>F.</i>) <i>paliferus</i> (Alcock, 1902)				?					X	X			X			3	99-720
Family Micrabaciidae																	
<i>Leptsamia formosissima</i> (Moseley, 1876)		X	X	X	X	X		X					X			3	55-780
<i>Stephanophyllia fungulus</i> Alcock, 1902				X	X						X		X			3	98-236
<i>Stephanophyllia complicata</i> Moseley, 1876									X		X		X			3	229-236
Family Rhizangiidae																	
<i>Cuticia</i> sp. cf. <i>C. natalensis</i> (Duncan, 1876)				X		?	X									1	34-366
Family Oculinidae																	
<i>Madrepora oculata</i> Linnaeus, 1758	X	X								X	X	X	X	X		6	732-1 270
* <i>Oulangia</i> sp. ²									X							7	18
Family Anthemiphylliidae																	
* <i>Anthemiphyllia denata</i> (Alcock, 1902)									X	X	X	X				3	193-494

Family Caryophylliidae

* <i>Caryophyllia ambrosia</i> Alcock, 1898	X	X		X	X	X	X	X	X	?	6	430-2 000
* <i>Caryophyllia grandis</i> Gardiner & Waugh, 1938			X	X	X	X	X	X	X	?	2	183-595
* <i>Caryophyllia scrobiosa</i> Gardiner & Waugh, 1938				X	X	X	X	X	X	X	3	535-960
* <i>Caryophyllia</i> sp. cf. <i>C. cornuiformis</i> Pourtales, 1868	?	?		X	X	X					5	91-320
* <i>Caryophyllia arcuata</i> Milne Edwards & Haime, 1848 ³							X				1	128-914
* <i>Caryophyllia ephyala</i> Alcock in Wood Mason & Alcock, 1891 ⁴			X	X	X	X	X	X	X	X	3	146-1 289
* <i>Caryophyllia epithecata</i> Gardiner, 1904 ⁵			X	X	X	X	X	X	X	X	4A	146-672
* <i>Caryophyllia profunda</i> Moseley, 1881			X	X	X	X	X	X	X	X	4B	80-755
** <i>Caryophyllia rugosa</i> Moseley, 1881			X	X	X	X	X	X	X	X	3	95-250
*? <i>Caryophyllia lamellifera</i> Moseley, 1881 ⁶							?	X		?	3	128-274
* <i>Caryophyllia elongata</i> sp. nov.			X	X	X	X					1	630-680
* <i>Caryophyllia</i> (P.) <i>zanzibarensis</i> Zou, 1984								X			1	238-302
* <i>Trochocyathus rhombocolumna</i> Alcock, 1902								X	X	X	3	110-229
* <i>Trochocyathus</i> sp. A			X	X	X	X	X	X	X	X	2	74-315
<i>Trochocyathus rawsonii</i> sensu Gardiner, 1904			X	X	X	X	X	X	X	X	4A	560-620
* <i>Trochocyathus</i> sp. cf. <i>T. rawsonii</i> Pourtales, 1874	?						X	X	X	X	5	750-780
* <i>'Caryophyllia' berteriana</i> Duchassaing, 1850 ⁷			X								1	165
* <i>Paracyathus</i> sp. ⁸							X	X	X	X	7	0-146
* <i>Paracyathus pruinosus</i> Alcock, 1902 ³							X	X	X	X	3	274
* <i>Polycyathus</i> sp.											?	?
<i>Stephanocyathus</i> (O.) <i>nobilis</i> (Moseley, 1873)	X	X		X	X	X	X	X	X	X	5	609-2 000
** <i>Stephanocyathus</i> (O.) <i>campaniformis</i> (von Marenzeller, 1904)	X	X									5	1 600-1 610
<i>Stephanocyathus</i> (A.) <i>spiniger</i> (von Marenzeller, 1888)			X	X	X	X	X	X	X	X	3	210-695
<i>Stephanocyathus</i> (A.) <i>explanans</i> (von Marenzeller, 1904)			X	X	X	X					2	183-614
<i>Labyrinthocyathus delicatus</i> (von Marenzeller, 1904)			X	X	X	X					4A	155-1 000
<i>Deltocyathus andamanicus</i> Alcock, 1898			X	X	X	X					2	240-1 463
<i>Deltocyathus rotulus</i> (Alcock, 1898)			X	X	X	X					3	510-1 986
<i>Deltocyathus</i> sp. A			X	X	X	X	?		X		7	207-315
<i>Desmophyllium cristagalli</i> Milne Edwards & Haime, 1848	X	X	X	X	X	X	X	X	X	X	6	81-2 000
* <i>Conorochus brunneus</i> (Moseley, 1881)							X	X	X	X	3	475-695
** <i>Autocyathus recidivus</i> (Dennant, 1906)							X	X	X	X	?	?
<i>Autocyathus juvenescens</i> von Marenzeller, 1904							X	X	X	X	1	302-463
** <i>Dasmomilia variegata</i> (Pourtales, 1871)	X	X	X	X	X	X	X	X	X	X	5	330-335
* <i>Asteromilia marchadi</i> (Chevalier, 1966)	X	X	X	X	X	X					5	57-229
* <i>Solenomilia variabilis</i> Duncan, 1873	X	X	X	X	X	X					6	366-1 079
** <i>Goniocorella dumosa</i> (Alcock, 1902)			X	X	X	X					3	760
* <i>Lophelia pertusa</i> (Linnaeus, 1758) ¹¹								X	X	X	6	450
* <i>Rhizomilia robusta</i> sp. nov.			X	X	X	X	X	X	X	X	1	66-150
* <i>Rhizomilia gigas</i> (Van der Horst, 1931) ¹⁰							X	X	X	X	1	183-366

TABLE 2 (cont.)

	Atlantic Ocean			South-West Indian Ocean							Indian Ocean			Pacific Ocean	Subantarctic	Distribution pattern	Depth (m) (Indian Ocean)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14			
Family Turbinoliidae																	
<i>Tropidocyathus lessoni</i> (Michelin, 1842)				X	X	X	X				X		X		3	62-421	
* <i>Tropidocyathus nascomatus</i> Gardiner & Waugh, 1938					X	X									1	183-457	
** <i>Thrypticorochus multilobatus</i> Cairns, 1989						X		X					X		3	347-925	
<i>Sphenotrochus</i> (S.) <i>aurantiacus</i> von Marenzeller, 1904			X	X	?										4A	155-366	
* <i>Sphenotrochus</i> (S.) <i>evexicostatus</i> sp. nov.				X	X	X		?							1	12-73	
* <i>Sphenotrochus</i> (S.) <i>imbricatocostatus</i> sp. nov.				X	X										1	37-347	
* <i>Sphenotrochus</i> (E.) <i>gilchristi</i> (Gardiner, 1904)			X	X											4A	24-165	
<i>Peponocyathus australiensis</i> (Duncan, 1870)	X	X		X		X					X		X		6	101-366	
Family Flabellidae																	
* <i>Flabellum</i> (U.) <i>apertum</i> Moseley, 1876			X			X					X				4B	863-1 400	
* <i>Flabellum</i> (U.) <i>japonicum bythios</i> subsp. nov.								X	X		X	X			2	1 095-1 720	
** <i>Flabellum</i> (U.) <i>loweyesi</i> Squires & Ralph, 1965					X			X	X				X		3	835-1 030	
** <i>Flabellum</i> (U.) <i>messum</i> Alcock, 1902								X							3	430-835	
* <i>Flabellum</i> (F.) <i>sibogae</i> sensu Gardiner, 1904 ¹²				X											1	567	
<i>Flabellum</i> (F.) <i>pavoninum</i> Lesson, 1831				X		X	X	X	X	X	X		X		3	98-665	
* <i>Truncatoflabellum inconsans</i> von Marenzeller, 1904			X	X											4A	100-155	
* <i>Truncatoflabellum</i> sp. cf. <i>T. stabile</i> (von Marenzeller, 1904)	X				X										5	1 250-1 520	
** <i>Truncatoflabellum formosum</i> Cairns, 1989				X	X								X		3	150-230	
** <i>Truncatoflabellum pusillum</i> Cairns, 1989					X								X		3	110-132	
* <i>Truncatoflabellum gardineri</i> sp. nov.				X											1	138	
* <i>Truncatoflabellum zuluense</i> sp. nov.				X											1	62-84	
* <i>Truncatoflabellum multispinosum</i> sp. nov.				X	X	X									1	62-183	
<i>Javania insignis</i> Duncan, 1876				X	X						X				3	74-255	
** <i>Placorocheles scaphula</i> Alcock, 1902				X				X					X		3	695-1 360	
Family Guyniidae																	
* <i>Guynia annulata</i> Duncan, 1872	X	X		X	X						X		X		6	112-286	
* <i>Stenocyathus vermiformis</i> (Pourtales, 1868)	X	X								X					6	80-672	

known only from the tropical south-west Indian Ocean, and the other 10 species (12 %, Table 2: pattern 2) are more widely distributed in the Indian Ocean. Although Briggs (1974) divided the tropical Indo-Pacific region into the western Indian Ocean Province and the Indo-Polynesian Province, separated at the Persian Gulf, he also stated that there is no obvious physical barrier between east Africa and the Malay Peninsula and urged caution in interpreting endemic faunas for either province. We agree. To assume that the 20 species now known only from the tropical south-west Indian Ocean are endemic to that region would be misleading. The finding of 11 new records for the Indian Ocean, nine of which were heretofore known only from the western Pacific, reinforces the supposition that the south-west Indian Ocean fauna is an outpost of an essentially homogeneous Indo-West Pacific fauna and, as the deep-water corals are better understood, the Indo-West Pacific component will probably increase at the expense of the 'endemic' and 'exclusively' Indian Ocean species.

Ten species (12 % of the 82 species) have a shared distribution with temperate regions to the south: eight species being found also off temperate South Africa (Table 2: pattern 4A) and two species occurring in the temperate/circum-Subantarctic regions (Table 2: pattern 4B).

The final category (Table 2: pattern 5) is perhaps of greatest interest because of its unexpected nature: seven (8,5 %) of the tropical south-west Indian Ocean azooxanthellates have a shared distribution in the Atlantic Ocean. Six of the species occur in the eastern Atlantic and five occur in the western Atlantic.

As mentioned in the introduction, at least 125 species of azooxanthellate Scleractinia are believed to occur in the tropical south-west Indian Ocean, which represents one of the highest diversities of this type of coral in the world oceans. For comparative purposes, the number of azooxanthellates in some other well-studied regions, in descending order of diversity, are: 140 species (estimate), New Caledonia region (Zibrowius in prep.); 116, tropical western Atlantic (Cairns 1979); 110 (estimate), Philippine region (Cairns 1989b); 102, Japanese region (Yabe & Eguchi 1942; Eguchi 1968; Cairns in prep.); 85, north-east Atlantic (Zibrowius 1980); 54, Hawaiian Islands (Cairns 1984); 48, South Australia-Victoria-Tasmania region (Cairns & Parker 1992); 37, entire Antarctic and Subantarctic region (Cairns 1982); 25, temperate north-east Pacific (Cairns in prep.); and 14, temperate north-west Atlantic (Cairns 1981).

BATHYMETRIC DISTRIBUTION

The azooxanthellate corals of the south-west Indian Ocean can be divided into three bathymetric zones: 0–300 m, 300–1 300 m and 1 300–2 000 m. These zones were established by tabulating the number of species occurring in each 100 m interval and then looking for depths at which major gains or losses of species occurred.

Sixty-eight species occur in the subtidal zone (0–300 m), slightly over half of which (35) occur only in this zone. Species of the Dendrophylliidae (21 species) and Caryophylliidae (22 species) predominate, as well as representatives of the Flabellidae (eight species), Turbinoliidae (seven species), Micrabaciidae (three species), Guyniidae (two species), Pocilloporidae, Oculinidae, Fungiacyathidae, Rhizangiidae and Anthemiphylliidae—the last five families each being represented by only one species.

The number of species in the subtidal zone reaches a maximum (49) in the 100–200 m interval, and then decreases abruptly to only 41 species in the 200–300 m

interval. Only 35 species occur at a depth range of 300–400 m, most of them also known from shallower depths, five appearing for the first time, but another 35 species do not cross this border from shallower water. Thus, the subtidal zone appears to be well isolated and we consider 300 m to be its lower boundary, which is 100 m lower than the generally accepted model of marine zonation suggested by Belyaev *et al.* (1959).

In the upper bathyal zone (300–1 300 m) the number of species steadily decreases from the lower boundary of the subtidal zone (41 species) to 1 300 m (only 12 species). This lower boundary is also 100 m deeper than that based on bivalve species investigated by Krylova (1989). We may thus conclude that the outer shelf margin and upper continental slope (0–1 300 m) are the most favourable zones for azooxanthellate corals. The upper region of the slope to 700 m is inhabited by the same families (with the exception of the Pocilloporidae) as occur in the subtidal zone. The families Guyniidae, Rhizangiidae and Anthemiphylliidae do not occur deeper than 700 m. Furthermore, six species of caryophylliids do not occur deeper than 700 m, and two are endemic to the 500–700 m interval. The families Fungiacyathidae, Guyniidae and Flabellidae each lose a species at depths below 700 m. Thus, it appears that the 300–700 m interval is populated by a transitional coral fauna, the lower boundary of this transitional region (700 m) lying 300 m shallower than was suggested in the general model of Belyaev *et al.* (1959) of 1 000 m.

The fauna of the lower bathyal zone (1 300–2 000 m) is the most isolated, consisting of 12 species, 10 of which have a broad bathymetric range. Three of the 12 lower bathyal species also range into the subtidal zone, seven occur as shallow as the upper bathyal zone, and two occur in the lower interval of the upper bathyal. No species makes a first appearance in this zone. Only three families are represented: Caryophylliidae (six species), Flabellidae (four species) and Fungiacyathidae (two species). Only six of the 12 species reach the depth of 2 000 m, the lower boundary of this zone. The position of the lower boundary of the bathyal zone is shallower by 1 000 m than the model of Belyaev *et al.* (1959), but this difference may be explainable due to a paucity of deep-water collections in the south-west Indian Ocean.

All boundaries established for the subtidal and bathyal zones, based on the azooxanthellate corals, coincide with those found for Brachiopoda and Bivalvia by Zezina (1976) and Krylova (1989), respectively. This is not surprising, since all three taxa belong to the same trophic feeding group: the sestonfeeders.

ECOLOGY

It is sometimes possible to predict the environment in which a deep-water coral lives by an analysis of the morphology of the coral, which is essentially an immobile organism with finely-tuned adaptations to variations in the environment. For this purpose, it is better to use the solitary (non-colonial) species because the more complex construction of colonial species may obscure the interpretation (Keller 1981). Analysis of this kind may also serve as a model for palaeoecological reconstructions.

In the subtidal zone of the tropical south-west Indian Ocean, in conditions of high water productivity (Bogorov *et al.* 1968; Koblenz-Mishke 1977), there are many kinds

of azooxanthellate Scleractinia of various sizes and shapes. The largest specimens and most diverse taxa settle on hard substrates, i.e. muddy sand, pebbles, rubble, or rocky bottoms covered with loose sediment. Species common to this environment are *Stephanophyllia complicata*, *S. fungulus*, *Dasmosmia variegata*, *Rhizosmia robusta* sp. nov., *Javania insignis*, *Flabellum pavoninum*, *Truncatoflabellum multispinosum* sp. nov., *T. inconstans*, and numerous dendrophylliids.

Another homogeneous coral association occurs on loose sandy bottoms. Most of the species of this association are part of the interstitial fauna, e.g. *Caryophyllia rugosa*, *C. cornuformis*, *Sphenotrochus evexicostatus* sp. nov., *S. gilchristi*, *S. aurantiacus*, *S. imbricaticostatus* sp. nov., *Peponocyathus australiensis*, *Aulocyathus juvenescens* and *Guynia annulata*. These species belong to three families—Caryophylliidae, Turbinoliidae and Guyniidae—but have many similar features: small, unattached coralla with a GCD usually less than 10 mm; low number of septa, usually 48 or fewer; dense skeletal elements; narrow, conical coralla; and smooth calicular margins. Species of *Truncatoflabellum* dwell on the sand in the same locations, but differ in having larger coralla (GCD often over 10 mm) and a trapezoid corallum shape resulting from asexual transverse division. However, their skeletal elements are dense and their calicular margins are smooth.

There may be many reasons for a small-sized coral association. Thiel (1975) believed that invertebrate groups that are faced with constant food restrictions consist, on average, of small individuals. My investigations (Keller 1978, 1989) on the coral associations of the abyssal region and mid-oceanic, bathyal submarine ridges, which both have low nutrient levels, confirm this assertion. However, in addition to their small size, corals in oligotrophic regions also adapt by having a deep fossa, a scalloped calicular margin—the exsert septa forming tall thecal extensions, and a delicate, fragile skeleton. These characteristics allow the coral to accomplish the function of support in the most economical way, which is important in low nutrient level regions. On the contrary, species forming the sandy-bottom associations have dense, robust coralla and their fossae are shallow, with smooth calicular margins due to little or non-exsert septa. This morphology is indicative of normal trophic conditions. Maps of the primary production and zooplankton distribution (Bogorov *et al.* 1968; Koblenz-Mishke 1977) confirm this hypothesis. We suppose that the small size of subtidal corals is related to their location on a shifting sand substrate, not favourable to their existence or normal development. The corals occurring on loose, mobile sand often possess fewer septa than average, possibly as a result of neotenic development, which is common in unfavourable conditions (Keller 1978).

As noted previously, species of three families (Fungiacyathidae, Micrabaciidae and Caryophylliidae) are widely distributed in the upper bathyal and transitional regions. These families have the greatest bathymetric ranges among the Scleractinia, because each includes one genus that occurs at abyssal depths. Fungiacyathidae is represented by three species of *Fungiacyathus*: *F. paliferus*, *F. stephanus* and *F. sibogae*; Caryophylliidae by two species of *Deltocyathus*: *D. andamanicus* and *D. rotulus*; and Micrabaciidae by *Letepsammia formosissima*. As noted before (Keller 1978), there are definite peculiarities in construction of scleractinian skeletons that make it possible for them to adapt to unfavourable environmental conditions, in particular, life in low nutrient levels associated with environments at great depths. This distinctive morpho-

logy consists of a flattened discoidal growth form, a widely open calice with a deep fossa, highly exsert septa, and a light fragile skeleton. Corals with such a morphology maximize the area for food capture and for respiration, and can live in conditions of high nutrient levels as well as being pre-adapted to survive in low nutrient levels.

Species of *Flabellum* (Flabellidae) also occur in the upper bathyal and transitional regions. In the nearshore areas and in other highly productive areas, such as over seamounts (e.g. Saya de Malha Bank), most species of this genus have a serrate calicular edge, a shallow fossa, a narrow elliptical calice with a smooth calicular margin, and numerous septa. The widely distributed *F. pavoninum* is a good example. Lower in the transitional region, but still in the upper bathyal zone where the productivity is not very high (Bogorov *et al.* 1968), two different types of *Flabellum* construction exist. Typical of the first type are *F. messum* and *F. lowekeyesi*, the latter being very common in the south-west Indian Ocean at depths of 800–1 000 m. Its adaptive characteristics are a deep fossa and large calice, a scalloped calicular edge, the septa of which are quite exsert, and a rather fragile skeleton. The shallower-water *F. messum* (430–835 m) has a similar morphology and both species are very similar to *F. marcus* Keller, 1981, which occurs on the oligotrophic mid-oceanic Marcus-Necker submarine ridge. The construction of these three species is well adapted to catching and digesting food in oligotrophic waters, since it requires less calcium carbonate and energy compared with a similarly-sized dense skeleton with a smooth calicular margin. A second, deeper-water group of *Flabellum* species typifies a second kind of skeletal construction, including the species *F. apertum* (863–1 400 m) and *F. japonicum bythios* subsp. nov. (1 095–1 720 m). These species, like the first type, have a deep fossa, an open calice, and a fragile skeleton, but are distinguished from the first group by having a flattened corallum, somewhat similar to that of *Stephanocyathus*.

Three species of *Caryophyllia*, two of which dwell in the upper bathyal and transitional zones, are also characterized by an open calice and highly exsert septa producing a scalloped calicular margin: *C. grandis* (183–490 m), *C. scobinosia* (535–960 m) and *C. ambrosia* (430–2 000 m). The morphology of *C. ambrosia* is most similar to *C. grandis*, the former replacing the latter at greater depth. The main difference between the two species is that the number of septa of the shallower species, *C. grandis*, is greater than that of the deeper *C. ambrosia*, which supports the correlation suggested by Keller (1978) of a decreasing septal number with increase in depth.

The upper bathyal species *C. profunda* (80–755 m) has a somewhat different morphology: a shallow fossa with only a slightly scalloped calicular margin. However, its shallow depth range is reflected in a relatively large number of septa (up to 96 septa and 24 pali). It is advantageous for this species to exist in unfavourable trophic conditions, because its numerous septa (and corresponding mesenteries) provide an increased area for food capture and absorption.

The four species of *Stephanocyathus* live in relatively deep water, two of them occurring in the upper bathyal zone—*S. explanans* (183–614 m) and *S. spiniger* (210–695 m), and two others in the lower bathyal—*S. campaniformis* (1 600–1 610 m) in the south-west Indian Ocean and the better known *S. nobilis* (609–2 000 m). All species in this genus are characterized by having a flattened corallum, an open calice, and highly exsert septa, which produce a scalloped calicular margin. As

mentioned above, corals with such a morphology are best adapted for living in waters having a poor nutrient level.

We conclude, therefore, that a certain kind of environment, i.e. low nutrient level, leads to a certain type of skeletal morphology that occurs in parallel in different families, in agreement with the law of homology series of variations (Vavilov 1967). However, for an accurate reconstruction of environmental conditions, either in the Recent or in the geologic past, it is necessary to analyse the entire coral assemblage at a particular depth. If in a community there exist species with exsert septa and scalloped margins and also flattened forms, it is not significant. However, if most or all of the species have highly exsert septa, a deep fossa, and a fragile skeleton, as is typical of those species in the bathyal of the south-west Indian Ocean, we may conclude that they lived in a region of low nutrient levels. This conclusion is in agreement with maps of primary production and zooplankton distribution published by Koblenz-Mishke (1977) and Bogorov *et al.* (1968).

MATERIAL AND METHODS

Material. The specimens that form the basis of this study derive primarily from three sources (see Station List). Many were obtained from 38 stations of cruises 7 and 8 of the Indian Ocean International Expedition, the specimens collected from waters of a wide range of depths (34–1 360 m) off Mozambique and Kenya using R.V. *Anton Bruun* in 1964 (see Anonymous 1965). Secondly, deeper-water (to 1 720 m) specimens were examined from the Madagascar and Mascarene plateaus, off south-eastern Mozambique and off Madagascar from 33 stations of the Russian research vessel *Vityaz* (cruise 17) in 1988–1989. Third, a collection of relatively shallow-water azooxanthellates (primarily 50–100 m) was studied, comprising specimens from 52 stations made by the R.V. *Meiring Naude* off Zululand, South Africa. The geographic and bathymetric data for all of these stations are listed in the Station List. The R.V. *Anton Bruun*, *Meiring Naude*, and some of the *Vityaz* specimens are deposited at the National Museum of Natural History, Washington, D.C. (NMNH), but most of the *Vityaz* specimens are deposited at the Institute of Oceanology, Moscow (IOM).

In addition to the newly reported material, previously reported specimens of historical interest were examined by the first author from the following institutions: BM (Gardiner 1904; Van der Horst 1926, 1931; Gardiner & Waugh 1938, 1939); ORI (part of Boshoff 1981); ZMA (Alcock 1902a, 1902b); and ZMB (Von Marenzeller 1904). Finally, a reference collection of Indian Ocean deep-water corals was examined in 1991 by the first author at the Station Marine d'Endoume, Marseille, but is not cited in this publication.

Methods. The geographic region considered in this report is the tropical south-west Indian Ocean (Fig. 2). The south-western border between the tropical and temperate regions has been variously defined from Algoa Bay to just south of Durban, but we have chosen to follow Briggs (1974) in setting this boundary at the mouth of the Kei River (28°22'E 32°41'S). The southern boundary of the region is somewhat arbitrarily taken to be 40°S; the eastern boundary, 70°E; the northern boundary, 2°S (border between Kenya and Somalia); and the western boundary, the coast of eastern Africa and a N–S line from the mouth of the Kei River to 40°S. The region includes



Fig. 2. Map of the region covered in this checklist.

the following countries: north-eastern South Africa, Mozambique, Tanzania (including Pemba and Zanzibar), Kenya and Madagascar; the following islands: Comores, Seychelles, Mauritius, Reunion and Rodrigues; and the following submarine features: Madagascar and Mascarene plateaus, Walters Shoal and Saya de Malha Bank.

Species synonymies are complete for records within the Indian Ocean, although additional citations are often given that provide more complete synonymies, descriptions, and/or good illustrations. In the 'New Records' sections, the station number is followed by the number of specimens examined, and finally the catalogue number (if any) or museum of deposition. Station data are found in a separate Station List. Types are deposited primarily at the NMNH, but some are also at the IOM and SAM (see text). The new species were distinguished and described by Cairns and thus should be

cited as: Cairns *in* Cairns & Keller. The descriptive, historical and zoogeographic sections are also the work of the first author; the bathymetric and ecology sections are the work of the second author.

Only those species new to the south-west Indian Ocean and taxa not definitively identified to the species level are illustrated. The scanning electron microscopy was done by the first author on a Cambridge Stereoscan 100.

The following abbreviations are used in the text:

Museums

BM	British Museum (Natural History), London
IOM	Institute of Oceanology, Moscow
NM	Natal Museum, Pietermaritzburg
NMNH	National Museum of Natural History, Washington, D.C.
ORI	Oceanographic Research Institute, Durban
SAM	South African Museum, Cape Town
USNM	United States National Museum (now the NMNH, Smithsonian, Washington, D.C.)
ZMA	Zoological Museum, Amsterdam
ZMB	Zoologisches Museum, Berlin

Vessels

AB.	R.V. <i>Anton Bruun</i>
JM	John Murray Expedition (H.E.M.S. <i>Mabihiss</i>)
MN	R.V. <i>Meiring Naude</i>
V	R.V. <i>Vityaz</i>

Morphological terms

GCD	Greater Calicular Diameter
GCD : LCD	Ratio of Greater Calicular Diameter to Lesser Calicular Diameter
SEM	Scanning Electron Microscopy
S _x , C _x , P _x	Septa, Costae, or Pali (respectively) of cycle designated by numerical subscript

SYSTEMATIC ACCOUNT

A checklist of species recorded from the tropical south-west Indian Ocean and their distribution is provided in Table 2.

Suborder ASTROCOENIINA

Family **Pocilloporidae**

Genus *Madracis*

Madracis sp. A

Fig. 3A–B

New records

V-2697, 1 branch, IOM; AB-372B, 1 colony, USNM 91499; AB-400C, 1 branch, USNM 91498.

Remarks

A well-preserved branch tip from Walters Shoal (Fig. 3A–B) measures 14.5 mm long and 2.2–2.5 mm in diameter, supporting about 20 corallites. Costae are highly echinulate and faintly striate. Corallites are circular to slightly elongate, each with 10 primary septa and traces of 10 secondary septa. Very small paliform lobes occur on inner edges of primary septa. Styliform columella massive.

Like most other genera containing shallow-water azooxanthellate species (e.g. *Culicia*, *Polycyathus*, *Oculina*, *Balanophyllia*, *Dendrophyllia* and *Tubastraea*), many species have been described (about 15 in the case of *Madracis*) but none of these genera has been comprehensively revised. Until a worldwide revision is available for this genus, we opt to leave these specimens unidentified to species.

At least three species of *Madracis* have been reported from the western Indian Ocean: an unidentified species reported by Gardiner & Waugh (1939) from off Pemba, Tanzania (73–165 m); *Madracis* sp. cf. *M. decactis* from the reefs of Tuléar, Madagascar (Pichon 1978); and *M. interjecta* von Marenzeller, 1907b, from the Gulf of Aqaba, Red Sea (see also Scheer & Pillai 1983; Fricke & Schuhmacher 1983) at 122–350 m.

Distribution

Off Mozambique; off Walters Shoal; 42–160 m.

Suborder FUNGIINA
Family **Fungiacyathidae**
Genus *Fungiacyathus*

Fungiacyathus (Bathyactis) sibogae (Alcock, 1902a)

Bathyactis sibogae Alcock, 1902a: 108; 1902c: 38 [part. —lectotype from *Siboga*–208].

Bathyactis symmetrica: von Marenzeller, 1904: 312–313, pl. 18 (fig. 25). Gardiner & Waugh, 1939: 231.

Bathyactis stabilis Gardiner & Waugh, 1939: 231–232, text-figs 1–2 [syn. nov.].

Fungiacyathus (Bathyactis) sibogae: Cairns, 1989b: 10–11, pl. 3 (figs d–k), pl. 4 (figs a–c) [synonymy].

New records

AB–365D, 3, USNM 91487; AB–369J, 3, USNM 91486; AB–370D, 1, USNM 91489; AB–373H, 2, USNM 91488; AB–373J, 3, USNM 91485.

Remarks

The south-west Indian Ocean specimens collected by R.V. *Anton Bruun* are indistinguishable from the lectotype of the species and to those reported by Cairns (1989b) from Indonesia. Gardiner & Waugh's (1939) specimens of *Bathyactis stabilis* and *B. symmetrica* (BM 1939.7.13.92 and 1939.7.13.93, respectively) and Von Marenzeller's (1904) *B. symmetrica* from *Valdivia*–245 (ZMB 5066) were examined by SDC and also found to be conspecific, the latter being 20.8 mm in calicular diameter.

Distribution

Indian Ocean: off Zululand, South Africa; off south-eastern Mozambique; off Pemba, Tanzania (Von Marenzeller 1904); off Kenya (Gardiner & Waugh 1939); off

south-west Madagascar; Gulf of Oman (Gardiner & Waugh 1939); 463–1 948 m. Elsewhere: Indonesia; 522–1 914 m (Cairns 1989b). *Fungiacyathus sibogae* is a new record for the Indian Ocean in name only, being previously reported by Gardiner & Waugh (1939) and Von Marenzeller (1904) as *B. stabilis* and *B. symmetrica*.

Fungiacyathus (Fungiacyathus) stephanus (Alcock, 1893)

Bathyactis stephanus Alcock, 1893: 149, pl. 5 (fig. 12, 12a).

Bathyactis symmetrica: Gardiner & Waugh, 1939: 230–231 [part.—John Murray–185].

Bathyactis stephana: Gardiner & Waugh, 1939: 232.

Fungiacyathus (F.) stephanus: Cairns, 1989b: 7–9, pl. 1 (figs a–k), pl. 2 (figs a–n) [synonymy and distribution].

New records

AB–370D, 1, USNM 91500; AB–373H, 4, USNM 91501, 1, SAM–H4574; AB–374D, 1, USNM 81534; AB–399C, 13, USNM 80859.

Distribution

Indian Ocean: off Natal (Gardiner & Waugh 1939) and Zululand, South Africa; off Mozambique; Gulf of Aden (Gardiner & Waugh 1939); Bay of Bengal (Alcock 1893); 880–2 000 m. Elsewhere: Indonesia; Philippines; 245–1 977 m (see Cairns 1989b).

Fungiacyathus (Fungiacyathus) paliferus (Alcock, 1902a)

Bathyactis palifera Alcock, 1902a: 108; 1902c: 38, pl. 5 (fig. 34, 34a).

Fungiacyathus sp. Zibrowius & Grygier, 1985: 119–120 (figs 6–7).

?*Fungiacyathus* sp. Zibrowius & Grygier, 1985: 120 (figs 8–9).

Fungiacyathus (F.) paliferus: Cairns, 1989b: 9–10, pl. 2 (figs c–i), pl. 3 (figs a–c) [synonymy and distribution].

New record

V–2722, 1, IOM.

Distribution

Indian Ocean: ?off Natal, South Africa (Zibrowius & Grygier 1985); Reunion (Zibrowius & Grygier 1985); Walters Shoal; 99–720 m. Elsewhere: Philippines; Indonesia; Great Australian Bight; 75–522 m (Cairns 1989b).

Family **Micrabaciidae**

Genus *Letepsammia*

Letepsammia formosissima (Moseley, 1876)

Fig. 3D

Stephanophyllia formosissima Moseley, 1876: 561–562; 1881: 201–204, pl. 4 (fig. 11), pl. 13 (figs 6–7), pl. 16 (figs 8–9). Van der Horst, 1927: 7. Gardiner & Waugh, 1939: 234. Boshoff, 1981: 24. Zibrowius & Grygier, 1985: 120.

Letepsammia formosissima: Owens, 1986: 487. Cairns, 1989b: 15–18, pl. 6 (fig. j), pl. 7 (figs g–i), pl. 8 (figs a–d) [synonymy and distribution].

Stephanophyllia: Williams, 1986, upper left colour photo.

New records

V-2608, 1, IOM, 1, USNM 91506; V-2626, 33, IOM, 6, USNM 91507; AB-358A, 2, USNM 91508; AB-370G, 10, USNM 75642; AB-370H, 1, USNM 75641; AB-372G, 2, USNM 75643; AB-390R, 1, USNM 91509; AB-390S, 30, USNM 75640; *Vema*-14 SAT6, 6, USNM 75644; MN-ZL3, 1, USNM 91505.

Remarks

An undescribed species of *Letepsammia* from the south-west Indian Ocean was mentioned first by Squires (1967: 505), and later by Owens (1986: 487) and Cairns (1989b: 16). This 'species' differs from typical *L. formosissima* in having a denser and more robust corallum, coarser septal teeth, and a papillose columella. Because these differences are slight and may be interpreted as intraspecific variation, a new species is not described at this time.

Distribution

Indian Ocean: off Nieca River mouth, South Africa (Zibrowius & Grygier 1985); off Durban, South Africa (Van der Horst 1927; Boshoff 1981); off Zululand; off Mozambique; off Pemba, Tanzania (Gardiner & Waugh 1939); off north-west Madagascar; 320–780 m. Elsewhere: Japan; Philippines; Hawaiian Islands; New Zealand; Australia; Tasmania; 97–828 m (Cairns 1989b).

Genus *Stephanophyllia**Stephanophyllia fungulus* Alcock, 1902b

Stephanophyllia fungulus Alcock, 1902b: 122–123; 1902c: 40, pl. 5 (fig. 35a–b). Gardiner & Waugh, 1939: 234. Pillai & Scheer, 1976: 14. Cairns, 1989b: 21–23, pl. 10 (figs a–k), pl. 11 (figs a–b) [synonymy and distribution].

Non *Stephanophyllia fungulus* Alcock. Boshoff, 1981: 24.

New records

AB-373B, 1, USNM 91510; MN-ZCC1, 1, USNM 91511.

Remarks

The specimen from MN-ZCC1 is very similar to the specimen illustrated by Cairns (1989b, pl. 10h) from off Natal.

Distribution

Indian Ocean: off Natal, South Africa (Cairns 1989b); off south-eastern Mozambique; Chagos Archipelago (Gardiner & Waugh 1939); Maldives Islands (Pillai & Scheer 1976); 98–236 m. Elsewhere: western Pacific Ocean; 15–635 m (Cairns 1989b).

Stephanophyllia complicata Moseley, 1876

Stephanophyllia complicata Moseley, 1876: 558; 1881: 198–201, pl. 4 (fig. 12), pl. 13 (figs 3–5). Van der Horst, 1926: 51; 1931: 11. Gardiner & Waugh, 1939: 234. Pillai & Scheer, 1976: 14. Cairns, 1989b: 21, pl. 12 (figs a–b).

New record

V-2804, 1, IOM.

Remarks

Three of the specimens reported by Van der Horst (1926, 1931) from Saya de Malha Bank are deposited at the USNM (81875).

Distribution

Indian Ocean: Saya de Malha Bank (Van der Horst 1926, 1931); Chagos Archipelago (Gardiner & Waugh 1939); Maldiv Islands (Pillai & Scheer 1976); 229–236 m. Elsewhere: Indonesia; 236 m (Moseley 1881).

Suborder FAVIINA

Family **Rhizangiidae**

Genus *Culicia*

Culicia sp. cf. *C. natalensis* (Duncan, 1876)

Fig. 3G

Cylicia tenella var. *natalensis* Duncan, 1876: 439–440, pl. 40 (fig. 3).

?*Culicia tenella*: Gardiner & Waugh, 1939: 230 (*John Murray*–123). Boshoff, 1981: 24.

New record

AB-421A, 2 colonies, USNM 91515.

Diagnosis

Larger colony (Fig. 3G) roughly spherical, about 4 cm in diameter, consisting of 50 closely spaced corallites. Corallites elongate and tubular, with circular calices up to 6.5 mm in diameter. Epitheca smooth and thin. Septal symmetry irregular: 10–12 primary septa, an equal number of secondary septa, and occasionally rudimentary tertiary septa in some sectors. Primary septa large, each having 4 or 5 prominent teeth, and joined to columella. Columella rudimentary and papillose.

Remarks

Specimens of *Culicia* have been reported at least four times from the south-west Indian Ocean: *C. excavata* (Milne Edwards & Haime, 1849) from the Cape of Good Hope; *C. tenella* var. *natalensis* (Duncan, 1876) from off Natal; *C. tenella* by Gardiner & Waugh (1939) from off Pemba, Tanzania; and *C. tenella* by Boshoff (1981) from off Mozambique and the Natal regions. In calicular size, septal number and arrangement, and distribution (i.e. tropical south-west Indian Ocean), the R.V. *Anton Bruun* specimens resemble *C. natalensis* (Duncan, 1876) more so than *C. excavata*, the latter having smaller corallites, fewer septa, and appearing to be restricted to temperate South Africa. The type of *C. natalensis* could not be found for comparison. *Culicia natalensis* is very similar to *C. hoffmeisteri* Squires, 1966, a species known only from South Australia at 0–29 m (Cairns & Parker 1992). When more specimens of the south-west Indian Ocean species are collected, detailed comparisons should be made to this Australian species.

Distribution

Off Natal, South Africa (Duncan 1876; Boshoff 1981); ?off Pemba, Tanzania (Gardiner & Waugh 1939); off Kenya; 34 m.

Family **Oculinidae**Genus *Madrepora**Madrepora oculata* Linnaeus, 1758

Madrepora oculata Linnaeus, 1758: 798. Zibrowius, 1974a: 762–766, pl. 2 (figs 3–5); 1980: 36–40, pl. 13 (figs A–P) [synonymy]. Cairns, 1979: 39–42, pl. 3 (fig. 2), pl. 4 (fig. 5), pl. 5 (figs 1–3) [synonymy].

Lophohelia investigatoris Alcock, 1898: 24–25.

Amphihelia (*Diplohelina*) *moeresbyi* Alcock, 1898: 25–26 [*fide* Zibrowius, 1974a].

Amphihelia oculata: von Marenzeller, 1904: 308–310, pl. 14 (fig. 1).

Madrepora kauaiensis: Gardiner & Waugh, 1939: 227.

Non *Madrepora oculata* Linnaeus. Boshoff, 1981: 27 [= a dendrophylliid, H. Zibrowius, pers. comm.].

Lophelia exigua: Boshoff, 1981: 37.

New records

V–2699, 7 branches, IOM; AB–365D, 2 branches, USNM 77210.

Distribution

Indian Ocean: Off Pemba, Tanzania (Gardiner & Waugh 1939); off south-west Madagascar; Madagascar Plateau; off Somalia (Von Marenzeller 1904); Red Sea (Von Marenzeller 1904); Arabian Sea (Alcock 1898); Laccadive Islands (Alcock 1898); St Paul and Amsterdam Islands (Zibrowius 1974a); 732–1 270 m. Elsewhere: cosmopolitan; 80–1 500 m (Cairns 1979).

Family **Anthemiphylliidae**Genus *Anthemiphyllia**Anthemiphyllia dentata* (Alcock, 1902a)

Fig. 3E

?*Discotrochus investigatoris* Alcock, 1893: 142, pl. 5 (fig. 5, 5a).

Discotrochus dentatus Alcock, 1902a: 104; 1902c: 27, pl. 4 (fig. 26). Gardiner & Waugh, 1938: 194.

Pillai & Scheer, 1976: 16.

Anthemiphyllia dentata: Cairns & Parker, 1992: 16–17, pl. 4 (figs e–f) [synonymy].

New record

V–2804, 1, IOM.

Distribution

Indian Ocean: Saya de Malha Bank; Arabian Sea (Alcock 1893; Gardiner & Waugh 1938); Maldive Islands (Gardiner & Waugh 1938; Pillai & Scheer 1976); 193–494 m. Elsewhere: off Japan; Indonesia; South Australia; 75–522 m (see Cairns & Parker 1992).

Suborder CARYOPHYLLIINA

Family Caryophylliidae

Genus *Caryophyllia**Caryophyllia ambrosia ambrosia* Alcock, 1898

Fig. 3H

Caryophyllia communis: Wood-Mason & Alcock, 1891a: 6. Alcock, 1898: 11–12.*Caryophyllia ambrosia* Alcock, 1898: 12, pl. 1 (fig. 1, 1a). Zibrowius, 1980: 63–65, pl. 25 (figs A–K) [synonymy].*Caryophyllia clavus*: van der Horst, 1931: 3 [*part.*—specimens from Laccadive Sea]. Gardiner & Waugh, 1938: 176.*Caryophyllia ambrosia ambrosia*: Cairns, 1979: 59.*New records*

V–2668, 12, IOM; V–2671, 1, IOM; V–2816, 4, IOM. Reference specimens: Gardiner & Waugh's (1938) *Caryophyllia clavus*: JM–119, 3, BM 1950.1.9.159–183; JM–122, 2, BM 1950.1.9.75–80; JM–185, 3, BM 1950.1.9.134–158.

Distribution

Indian Ocean: off Pemba and Zanzibar, Tanzania (Gardiner & Waugh 1938); Saya de Malha Bank; Madagascar Plateau; Gulf of Aden (Gardiner & Waugh 1938); Maldive Islands (Van der Horst 1931); Laccadive Islands (Alcock 1898); 430–2 000 m. Elsewhere: western and eastern Atlantic; 1 600–2 670 m (Zibrowius 1980).

Caryophyllia grandis Gardiner & Waugh, 1938*Caryophyllia clavus*: von Marenzeller, 1904: 281 [*part.*—*Valdivia*—186, pl. 16 (fig. 9, 9I)].*Caryophyllia grandis* Gardiner & Waugh, 1938: 177, pl. 1 (fig. 2). Pillai & Scheer, 1976: 16. Zibrowius & Gili, 1990: 32.*New records*

V–2631, 12, IOM, 1, USNM 91521; 12 miles (19 km) north of Durban, 183–220 m, 4, USNM 62497. Reference specimens: 4 syntypes of *C. grandis* from JM–145, BM 1950.1.9.211–225.

Remarks

Caryophyllia grandis is similar to *C. ambrosia*, both having unattached coralla of approximately the same size. To reiterate and add to Gardiner & Waugh's (1938) distinctions, *C. grandis* has a brownish theca; more crowded septa (and more septa than *C. ambrosia* at a corresponding size, sometimes up to a full fifth cycle); narrower pali; less exsert septa; and a shallower depth range (183–595 m vs 430–2 670 m). Comparisons to another unattached, cornute species, *C. valdiviae*, known only from the Walvis Ridge and off north-west Africa (882–1 230 m), are made by its authors Zibrowius & Gili (1990).

Distribution

Off Natal, South Africa (Zibrowius & Gili 1990); off south-eastern Mozambique; Maldive Islands (Gardiner & Waugh 1938); ?off western Sumatra (Von Marenzeller 1904); 183–595 m.

Caryophyllia scobinosa Alcock, 1902a

Caryophyllia scobinosa Alcock, 1902a: 90; 1902c: 8, pl. 1 (fig. 2, 2a). Gardiner & Waugh, 1938: 177–178. Keller, 1976: 17–18.

Caryophyllia clavus: von Marenzeller, 1904: 281 [part. — *Valdivia*—246, pl. 16 (fig. 9c–g, but not 9h)].

New records

V–2650, 1, IOM; V–2699, 2, IOM; AB–365D, 11, USNM 91519.

Distribution

Indian Ocean: off Pemba and Dar es Salaam, Tanzania (Von Marenzeller 1904; Gardiner & Waugh 1938; Keller 1976); south-west of Madagascar; off Walters Shoal, Madagascar Plateau; 535–960 m. Elsewhere: Celebes and Sulu Seas; 786–805 m.

Caryophyllia sp. cf. *C. cornuformis* Pourtalès, 1868

Fig. 3C, F

?*Caryophyllia cornuformis*: Gardiner & Waugh, 1938: 179, text-fig. 2.

New records

V–2626, 1, IOM; AB–370G, 32, USNM 91525, 1, SAM–H4585; AB–370H, 1, USNM 91526.

Remarks

Both Cairns (1979) and Zibrowius (1980) stated that Gardiner & Waugh's (1938) south-west Indian Ocean specimens of *C. cornuformis* were not that species, but did not state which species the *John Murray* specimens are. Comparisons of our new records to typical western Atlantic *C. cornuformis* show them to be very similar in size, shape, and septal and palar arrangement. The south-west Indian Ocean specimens differ only in having a thinner, sometimes ridged, non-porcellaneous theca, and some specimens have an intact base. It is suggested that two similar species may be involved: one very similar, if not identical, to *C. cornuformis*, which always has a broken base and irregular septal symmetry, and another as yet unnamed species (illustrated by Gardiner & Waugh 1938) that has an intact base and hexameral (three cycles) symmetry.

Distribution

Indian Ocean: off south-western Mozambique; ?off Pemba and Zanzibar, Tanzania (Gardiner & Waugh 1938); ?Gulf of Aden (Gardiner & Waugh 1938); 91–347 m. Distribution of *C. cornuformis*: western Atlantic from Brazil to 63°N at 37–931 m (Cairns 1979) and eastern Atlantic in area bounded by Celtic Sea, Azores, and Morocco at 1 300–2 200 m (Zibrowius 1980).

Caryophyllia profunda Moseley, 1881

Caryophyllia profunda Moseley, 1881: 138–139, pl. 1 (fig. 6) [part. — not specimen from Cape Verde Islands]. Von Marenzeller, 1904: 298. Zibrowius, 1974a: 751–755, pl. 1 (figs 1–10) [synonymy].

Cairns, 1982: 17–19, pl. 5 (figs 1–5) [synonymy]. Zibrowius & Gili, 1990: 25–26, pl. 4 (figs L–R). *Caryophyllia cyathus*: von Marenzeller, 1904: 295, pl. 16 (fig. 6).

New records

V-2686, 12, IOM, 1, USNM 91527; V-2722, 3, IOM; V-2731, 11, IOM; V-2733, 9, IOM.

Distribution

Indian Ocean: Agulhas Bank and Cape Agulhas (Von Marenzeller 1904); Madagascar Plateau; St Paul and Amsterdam Islands (Zibrowius 1974a); 80–755 m. Elsewhere: circum-Subantarctic; 35–1 116 m (Cairns 1982).

Caryophyllia rugosa Moseley, 1881

Fig. 3I

Caryophyllia rugosa Moseley, 1881: 141–143, pl. 1 (fig. 8). Cairns, 1984: 11–13, pl. 2 (figs A–B), pl. 4 (fig. I) [synonymy].

New records

AB-371E, 6, USNM 77212; AB-371F, 5, USNM 77213; *Manihine* 381–1, 2, USNM 91528; MN-ZD4, 2, USNM 91529; MN-ZQ8a, 1, USNM; JM-157 (attached to a colony of *Balanophyllia diffusa*), 1, BM 1950.1.6.35.

Distribution

Indian Ocean: off Zululand; off south-eastern Mozambique; off Mombasa, Kenya; off Maldiv Islands; 95–250 m. Elsewhere: Hawaiian Islands; Philippines; Ceram Sea; Japan; Bikini; 71–230 m (Cairns 1984).

Caryophyllia elongata sp. nov.

Fig. 4A–B

Records

Holotype: V-2716, 1, IOM.

Description

Corallum attached, subcylindrical, straight, and elongate: 25,6 mm in height, 9,3 × 7,9 mm in calicular diameter, and 5,7 mm in pedicel diameter. Costae poorly developed, only slightly ridged C₁ and C₂ present near calice. Theca otherwise porcellaneous, covered by low, rounded granules. Corallum primarily white, but theca light brown near calice.

Septa hexamerally arranged in four complete cycles (48 septa) according to the formula: S₁ > S₂ > S₄ > S₃. S₁ moderately exsert (2–2,5 mm), with slightly sinuous inner edges that reach about three-quarters distance to columella. S₂ slightly less exsert and equally sinuous, extending about two-thirds distance to columella. S₃ least exsert and smallest septa, extending only about half distance to columella. S₄ twice as exsert and slightly wider than S₃, both cycles having sinuous inner edges. Septal granules prominent, usually rectangular in profile, sometimes extending as short ridges paralleling inner septal edge. Twelve P₃ form a deeply recessed palmar crown, each palus about 1,2 mm wide, highly sinuous, and separated from its respective S₃ by a deep and

narrow notch. Each couple of P_3 within a system are slightly closer to each other than to those of adjacent systems, giving the impression of paired pali. Fossa quite deep, containing the palar crown and even deeper columella, consisting of two narrow fascicular elements.

Remarks

Among the 56 Recent species of *Caryophyllia* listed by Cairns (1991), 18 have attached coralla with septa hexamerally arranged in four cycles, and in only five of these species are the S_4 larger than the S_3 , the set of characters found in *Caryophyllia elongata* sp. nov.: *C. polygona* Pourtalès, 1878; *C. calveri* Duncan, 1873; *C. alberti* Zibrowius, 1980; *C. atlantica* (Duncan, 1873); and *C. panda* Alcock, 1902a. *Caryophyllia elongata* is distinguished from these species by having S_1 larger than S_2 (S_1 and S_2 are equal in size in most species), a very deep fossa, and deeply recessed, 'paired' pali.

Etymology

The species name *elongata* (from the Latin *elongatus*, prolonged) is an allusion to the elongate corallum of this species.

Distribution

Known only from the type locality of 33°17'S 44°55'E (Madagascar Plateau, off Walters Shoal), 630–680 m.

Subgenus *Caryophyllia* (*Premocyathus*)

Caryophyllia (*Premocyathus*) *zanzibarensis* Zou, 1984 [comb. nov.].

Caryophyllia compressa Gardiner & Waugh, 1938: 180, pl. 2 (fig. 4) [junior secondary homonym of

Caryophyllia (*Premocyathus*) *compressus* Yabe & Eguchi, 1942].

?*Trochocyathus pileus*: Gardiner & Waugh, 1938: 187.

Caryophyllia zanzibarensis Zou, 1984: 52, 53 [replacement name for *C. compressa* Gardiner & Waugh, 1938].

New record

Manihine 381–3, 4, USNM 91542.

Remarks

This species is transferred to the subgenus *Premocyathus* based on its highly compressed corallum and carinate thecal edges. Other Recent species in this subgenus include: *C. (P.) compressus* Yabe & Eguchi, 1942; *C. (P.) spinacarens* (Moseley, 1881), comb. nov.; *C. (P.) burchae* Cairns, 1984; and ?*C. (P.) dentiformis* (Alcock, 1902b). *Caryophyllia* (*Premocyathus*) *zanzibarensis* is most similar to *C. (P.) spinacarens*, differing primarily in having fewer septa and in being more compressed.

Distribution

Off north-eastern Tanzania, Maziwi Island (Gardiner & Waugh 1938); 238–302 m.

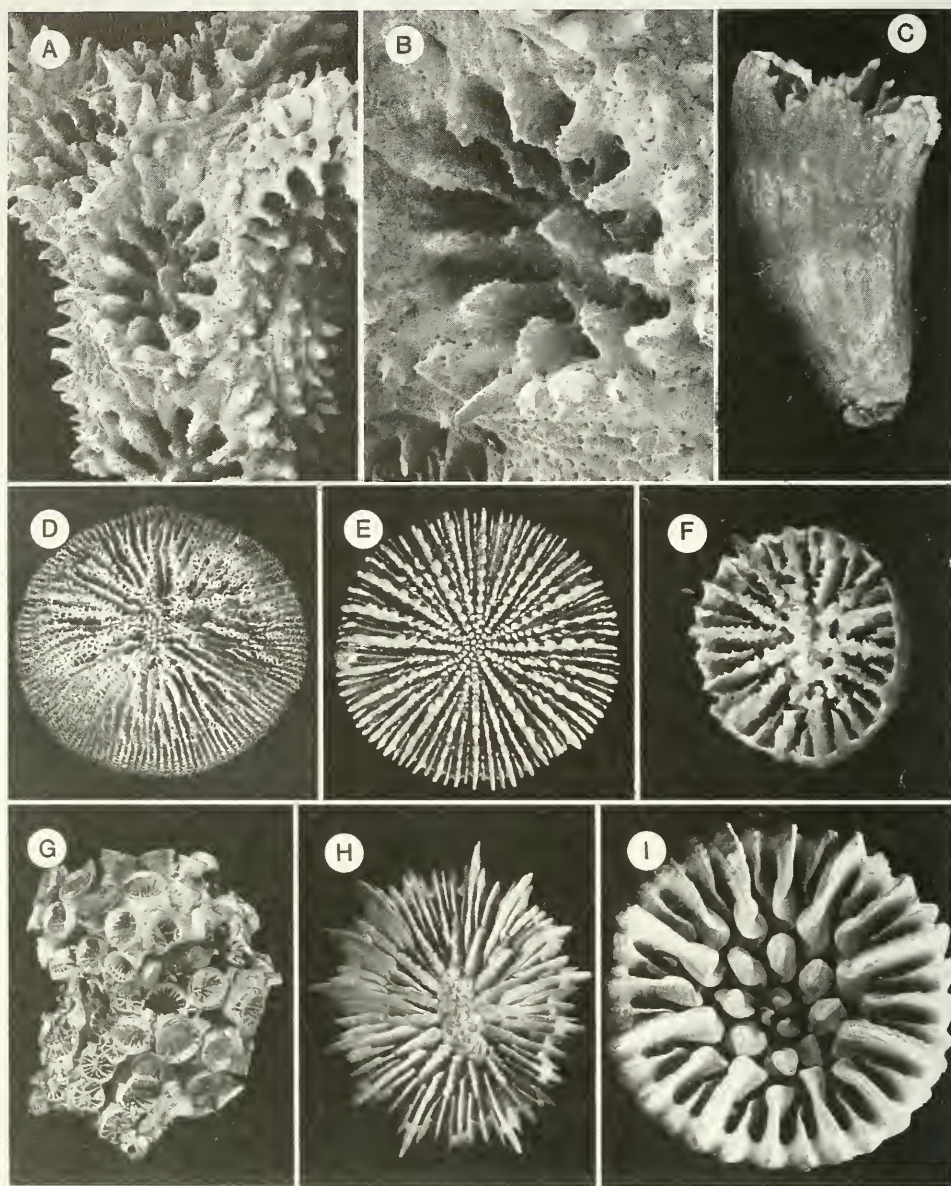


Fig. 3. A-B. *Madracis* sp. A, V-2697, IOM, branch and calicular views. A $\times 10$, B $\times 20$. C, F. *Caryophyllia* sp. cf. *C. cornuformis*, V-2626, IOM, lateral and calicular views. C $\times 5,8$, F $\times 6,7$. D. *Letepsammia formosissima*, V-2608, USNM 91506, calice. $\times 1,3$. E. *Anthemiphyllia dentata*, V-2804, IOM, calice. $\times 1,4$. G. *Culicia* sp. cf. *C. natalensis*, AB-421A, USNM 91515, colony. $\times 0,9$. H. *Caryophyllia ambrosia ambrosia*, V-2668, IOM, calice. $\times 1,3$. I. *Caryophyllia rugosa*, AB-371E, USNM 77212, calice. $\times 9,4$.

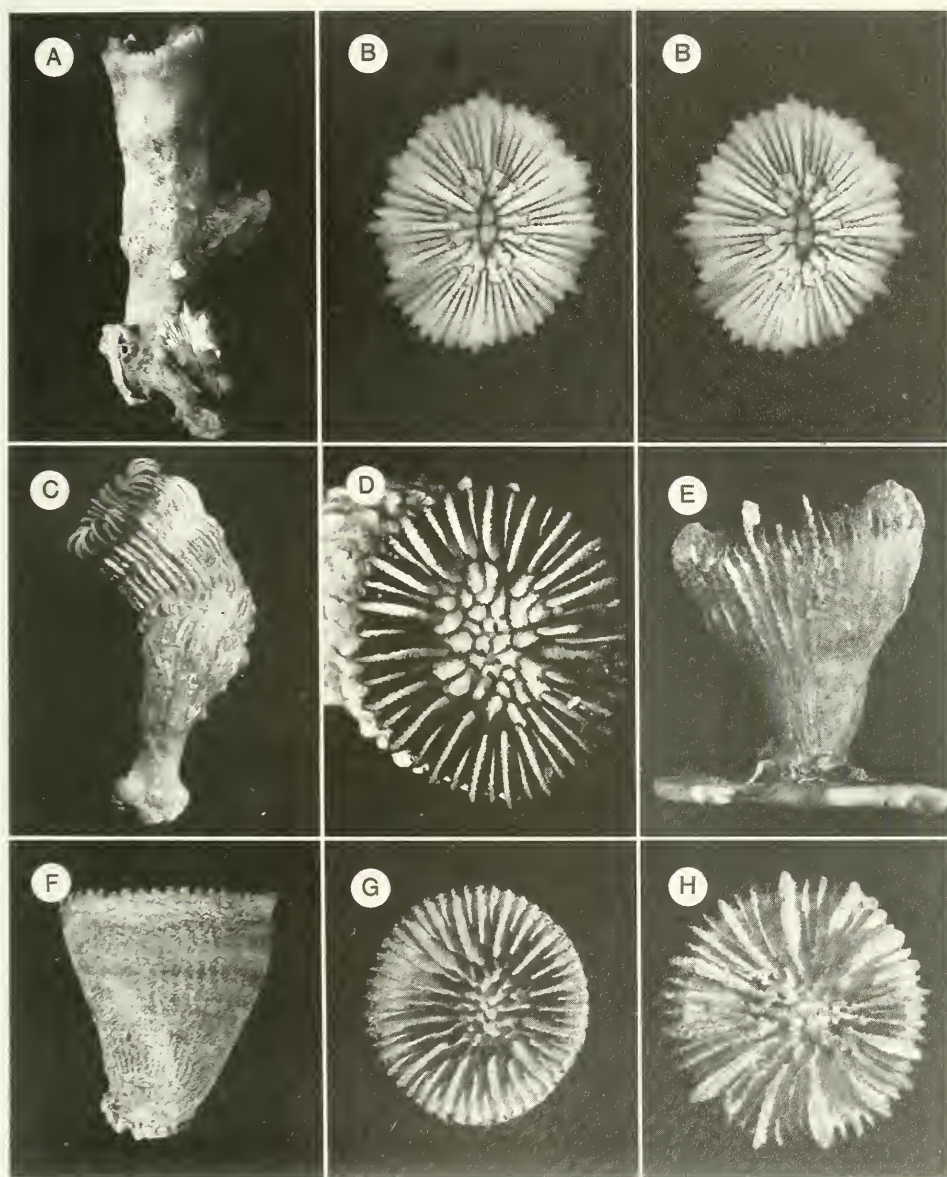


Fig. 4. A-B. *Caryophyllia elongata* sp. nov., V-2716 (holotype), lateral and stereo calicular views. A $\times 1,6$, B $\times 3,9$. C-D. *Trochocyathus* sp. A, V-2662, IOM, lateral and calicular views. C $\times 1,7$, D $\times 4,5$. E, H. *Trochocyathus* sp. cf. *T. rawsonii*, V-2733, USNM 91568, lateral and calicular views. E $\times 3,6$, H $\times 3,3$. F-G. *Conotrochus brunneus*, AB-365D, USNM 91556, lateral and calicular views. F $\times 3,5$, G $\times 3,9$.

Genus *Trochocyathus**Trochocyathus rhombocolumna* Alcock, 1902c

Trochocyathus rhombocolumna Alcock, 1902c: 16, pl. 2 (fig. 12).

Paracyathus gardineri: Gardiner & Waugh, 1938: 183–184 (part. —JM–157, pl. 3 (fig. 5)).

New records

AB–371E, 5, USNM 91563; AB–371F, 2, USNM 91564. Reference material: Gardiner & Waugh's (1938) *P. gardineri*: JM–157, 4, BM 1950.1.9.724–826; JM–106, 1, BM 1950.1.9.718.

Remarks

Specimens herein reported from off Mozambique were compared to those identified by Gardiner & Waugh (1938) as *Paracyathus gardineri* from the Maldives Islands (JM–157) and found to be conspecific; however, the *John Murray* specimen from off Tanzania (JM–106) was too damaged to identify. Several specimens from the Maldives Islands are extremely similar to the figured holotype of *T. rhombocolumna*. A peculiarity of this species is that not only are the S_4 slightly wider than the S_3 , but those S_4 adjacent to S_1 are wider than those adjacent to S_2 (about equal in width as an S_2).

As noted by Cairns (1984), the Indian Ocean specimens reported by Gardiner & Waugh (1938) as *P. gardineri* Vaughan, 1907, are not conspecific with that Hawaiian species, the former differing in having a basal attachment, more crowded septa, and transverse costae.

Distribution

Off south-western Mozambique; Maldives Islands (Gardiner & Waugh 1938); 110–229 m. Elsewhere: Sulu Archipelago (Alcock 1902c); 522 m.

Trochocyathus sp. A

Fig. 4C–D

Records

V–2662, 1, IOM; V–2803, 1, USNM 91567; AB–371F, 2, USNM 91565; MN–ZDD3, 1, USNM 91566.

Diagnosis

Corallum ceratoid and firmly attached either basally or laterally by epithecal bands. Coralla up to 10.3×9.1 mm in calicular diameter and 15 mm in height. Costae granular and well developed; transverse sculpturing not present. Corallum light brown, especially near calice. Septa hexamerally arranged in four cycles according to the formula: S_1 and $S_2 > S_3$ and S_4 . All septa have straight, vertical inner edges, except the S_3 , which are sinuous. Pali occur before the highest three cycles, the P_2 and P_3 about the same size, the P_3 about twice that width. All pali extend to columella. Columella papillose, consisting of 5–12 elements in an elliptical field.

Remarks

Trochocyathus sp. A is similar to *T. rhombocolumna* in having robust paler and columellar elements and having 48 septa, but differs in having: P_3 recessed from the columella, forming chevrons with the P_2 ; longitudinal (not transverse) costae; less crowded septa; brown theca; and equally wide S_1 and S_2 .

Distribution

Off Zululand, South Africa; off south-eastern Mozambique; south-west of Madagascar; Saya de Malha Bank; 74–315 m.

Trochocyathus rawsonii sensu Gardiner, 1904

Non *Trochocyathus rawsonii* Pourtalès, 1874: 35.

Trochocyathus rawsonii: Gardiner, 1904: 100–103, pl. 1 (fig. 2a–b), pl. 2 (figs A–K).

New record

MN–SM232, 3, USNM 77220. Reference specimen: *T. rawsonii* of Gardiner (1904, pl. 1 (fig. 2)), 1, BM 1950.1.10.112.

Remarks

As noted by Cairns (1979) and Zibrowius & Gili (1990), the South African specimens reported by Gardiner (1904) as *T. rawsonii* are incorrectly identified and probably represent an undescribed species. The South African specimens differ in having elongate, often curved coralla attached by a slender pedicel; better developed costae; and a paucity of S_5 . But, as stated above, until this genus is better known, we prefer not to introduce a new name for this species at this time, but await Zibrowius' anticipated faunistic revision, which will include many more specimens of this taxon.

Distribution

Off South Africa from Cape of Good Hope to Buffalo River (Gardiner 1904); 560–620 m (depths of Gardiner's specimens unknown).

Trochocyathus sp. cf. *T. rawsonii* Pourtalès, 1874

Fig. 4E, H

?*Trochocyathus rawsonii* Pourtalès, 1874: 35, pl. 6 (figs 7–10). Cairns, 1979: 77–79, pl. 13 (figs 5–7), pl. 14 (figs 1–6) [synonymy].

Non *Trochocyathus rawsonii* Pourtalès. Gardiner, 1904: 100–103.

New records

V–2608, 4, IOM; V–2731, 1, IOM; V–2733, 1, USNM 91568.

Remarks

Although Gardiner's (1904) records of *T. rawsonii* are thought to be misidentified, three specimens collected off Madagascar and the Madagascar Plateau are indistinguishable from small specimens of the attached, trochoid form of *T. rawsonii* described and figured by Cairns (1979: 77, pl. 13 (fig. 6)). The largest of the three

specimens (V-2608) is 11,6 mm in calicular diameter and 13,4 mm in height, having 48 septa arranged in four complete cycles.

Distribution

Indian Ocean: off north-western Madagascar and off Walters Shoal, Madagascar Plateau; 750–780 m. Distribution of *T. rawsonii*: Georgia to Brazil; 82–622 m (Cairns 1979).

Genus *Stephanocyathus*

Stephanocyathus (Odontocyathus) nobilis (Moseley, 1873)

Fig. 5D–E

Ceratotrochus nobilis Moseley, 1873: 402, text-fig. 3.

Stephanotrochus nobilis: Moseley, 1881: 155, pl. 3 (fig. 3a–b).

Stephanotrochus nitens Alcock in Wood-Mason & Alcock, 1891a: 7–8. Alcock, 1898: 18–19, pl. 2 (fig. 6, 6a); 1902d, text-fig. 92.

Stephanotrochus oldhami Alcock, 1894: 187–188; 1898: 19–20.

Stephanocyathus nobilis: Gardiner & Waugh, 1938: 189–192, pl. 6 (figs 13, 15). Pillai & Scheer, 1976: 16. Zibrowius, 1980: 101–103, pl. 51 (figs A–K) [synonymy].

Non *Stephanocyathus nobilis*: Boshoff, 1981: 39–40 (= *S. explanans*). Zou, 1988: 74–75 (= *S. weberianus*).

Stephanocyathus (Odontocyathus) nobilis: Cairns, 1979: 110–111, pl. 20 (figs 7, 10).

New records

V-2629, 6, IOM, 1, USNM 91543; V-2653, 3, IOM; V-2814, 2, IOM; AB-399B, 1, USNM 91544; AB-399C, 28, USNM 91545, 2, SAM-H4576.

Remarks

Although Zibrowius (1980) expressed reservation about the authenticity of Indian Ocean records of *S. nobilis* (type locality, Azores), comparison of Indian Ocean specimens with those from the eastern Atlantic, including the holotype, convince us that they are the same species, a conclusion also reached by Zou (1988); however, we do not include western Pacific specimens as *S. nobilis*. Although not examined (types presumably deposited in the Indian Museum, Calcutta), we concur with Gardiner & Waugh (1938) that *S. nitens* Alcock, 1891a (in Wood-Mason & Alcock), and *S. oldhami* Alcock, 1894, are undoubtedly junior synonyms of *S. nobilis*, but agree with Zibrowius (1980) that *S. weberianus* Alcock, 1902a, and *S. campaniformis* von Marenzeller, 1904, are distinct species.

Distribution

Indian Ocean: off south-eastern Mozambique; off Zanzibar, Tanzania (Gardiner & Waugh 1938); off Mombasa, Kenya (Gardiner & Waugh 1938); off south-western Madagascar; off Saya de Malha Bank; Gulf of Aden (Gardiner & Waugh 1938); Arabian Sea off India (Wood-Mason & Alcock 1891a; Alcock 1894); Maldives Islands (Gardiner & Waugh 1938; Pillai & Scheer 1976); 609–2 000 m. Elsewhere: off England; Azores; and Gulf of Guinea (Zibrowius 1980); off Brazil (Cairns 1979); 763–2 200 m.

Stephanocyathus (Odontocyathus) campaniformis (von Marenzeller, 1904)

Fig. 5A–B

Stephanotrochus campaniformis von Marenzeller, 1904: 302–304, pl. 18 (fig. 20, 20a).*Stephanocyathus campaniformis*: Zibrowius & Gili, 1990: 32–35, pl. 4 (figs A–K), pl. 5 (figs E–J) [synonymy].*New record*

V–2674, 1, IOM.

Remarks

Stephanocyathus campaniformis is very similar to *S. nobilis*, the major differences being its smaller adult size (distance from centre of base to edge break = 7,5–11,5 mm vs 10–15 mm for adult *S. nobilis*), and its characteristic bell shape, usually with a much higher H : W ratio than *S. nobilis* (i.e. 0,65–1,3 mm vs 0,42–0,61 mm for *S. nobilis*). The south-west Indian Ocean specimen, 29,5 mm in calicular diameter and 19,2 mm in height (H : W = 0,65), was compared to topotypic specimens of *S. campaniformis* reported by Zibrowius & Gili (1990) from the Walvis Ridge (USNM 86873–86876), the Indian Ocean specimen being very similar to a specimen figured by Zibrowius & Gili (1990, pl. 4 (figs F–G)).

Distribution

Indian Ocean: south-west Indian Ridge south of Madagascar Plateau; 1 600–1 610 m. Elsewhere: Walvis Ridge, off Namibia; 882–1 230 m (Zibrowius & Gili 1990).

Stephanocyathus (Acinocyathus) spiniger (von Marenzeller, 1888)*Stephanotrochus spiniger* von Marenzeller, 1888: 20–21.*Odontocyathus spiniger*: Eguchi, 1968: C39–C40, pl. C20 (figs 12–14), pl. C23 (figs 1–2) [synonymy].*Stephanocyathus spiniger*: Boshoff, 1981: 39.*Stephanocyathus (Acinocyathus) spiniger*: Wells, 1984: 209, figs 2.10–13 [synonymy]. Cairns & Parker, 1992: 26–27, pl. 7 (figs g–i) [synonymy].*New records*

V–2635, 4, IOM; AB–365D, 14, USNM 77215, 1, SAM–H4595.

Distribution

Indian Ocean: off Durban, South Africa (Boshoff 1981); off south-eastern Mozambique; off south-western and northern Madagascar; 210–695 m. Elsewhere: Japan; Philippines; Indonesia; Great Australian Bight; 120–560 m (Cairns & Parker 1992).

Stephanocyathus (Acinocyathus) explanans (von Marenzeller, 1904)*Stephanotrochus explanans* von Marenzeller, 1904: 304–307, pl. 18 (fig. 19a–b).*Stephanocyathus explanans*: Gardiner & Waugh, 1938: 192.*Stephanocyathus nobilis*: Boshoff, 1981: 39.*New records*

19 km north of Durban, South Africa, 183–220 m, 4, USNM 62500.

Remarks

Although having the same size range, *S. explanans* differs from *S. spiniger* in having shorter, thinner costal spines; having much less exsert septa ($S_1 = S_2$, whereas S_1 of *S. spiniger* are much larger than S_2); and in lacking corallum pigmentation.

Distribution

Off Durban, South Africa (Boshoff 1981); off Pemba and Zanzibar, Tanzania (Von Marenzeller 1904); west of Sumatra (Von Marenzeller 1904); 183–614 m.

Genus *Labyrinthocyathus**Labyrinthocyathus delicatus* (von Marenzeller, 1904)

Ceratotrochus delicatus von Marenzeller, 1904: 302, pl. 18 (fig. 18).

Cyathoceras cornu: Gardiner, 1904: 121–122.

Labyrinthocyathus sp. Cairns, 1979: 70, pl. 11 (figs 10–11).

Labyrinthocyathus delicatus: Zibrowius & Gili, 1990: 44.

New records

V–2637, 2, IOM; AB–357E, 1, USNM 77219; MN–SM162, 1, USNM 91546.

Distribution

Known only from the Indian Ocean off South Africa, from Cape Town to Durban (Von Marenzeller 1904; Gardiner 1904; Cairns 1979), and off south-eastern Mozambique; 155–1 000 m.

Genus *Deltocyathus**Deltocyathus andamanicus* Alcock, 1898

Fig. 5F

Deltocyathus andamanicus Alcock, 1898: 16–17, pl. 1 (fig. 5, 5a). Gardiner & Waugh, 1938: 196. Pillai & Scheer, 1976: 16.

Non *Deltocyathus* sp. cf. *D. andamanicus*: Cairns, 1984: 15, pl. 3 (figs A–B).

New record

Manihine 381–63, 1, USNM 91548.

Remarks

At least eight species of *Deltocyathus* have been reported from the Indian Ocean: *D. andamanicus* Alcock, 1898; *D. rotulus* (Alcock, 1898); *D. murrayi* Gardiner & Waugh, 1938; *D. varians* Gardiner & Waugh, 1938; *D. sarsi* (Gardiner & Waugh, 1938); *D. nascornatus* (Gardiner & Waugh, 1938); *Deltocyathus* sp. sensu von Marenzeller, 1904; and *D. italicus* sensu Zibrowius, 1974a. The species *D. minutus* Gardiner & Waugh, 1938, and *D. lens* Alcock, 1902, pertain to the genus *Feponocyathus* (see Cairns 1989b: 30). The specimen reported herein, 15.5 mm in calicular diameter, corresponds to the original description and illustrations of Alcock's *D. andamanicus*.

Distribution

Off Zanzibar, Tanzania (Gardiner & Waugh 1938); Gulf of Aden (Gardiner & Waugh 1938); Maldiv Islands (Gardiner & Waugh 1938; Pillai & Scheer 1976); Andaman Sea (Alcock 1898); 240–1 463 m.

Deltocyathus rotulus (Alcock, 1898)

Fig. 5I

Trochocyathus rotulus Alcock, 1898: 16, pl. 2 (fig. 1, 1a).

Deltocyathus fragilis Alcock, 1902a: 99–100; 1902c: 21, pl. 2 (fig. 15, 15a).

Deltocyathus rotulus: van der Horst, 1931: 6. Gardiner & Waugh, 1938: 196.

New records

AB–365C, 9, USNM 91549; AB–389C, 1, USNM 91550. Reference material: Gardiner & Waugh's (1938) *D. rotulus* from JM–119, 2, BM 1950.1.9.1159–1162.

Remarks

We concur with Gardiner & Waugh's (1938) evaluation that *D. fragilis* is a junior synonym of *D. rotulus*, even though the type specimens of each species have a different number of septa: 96 and 72, respectively. Of the approximately 15 valid Recent species in the genus, only one other, *D. magnificus* Moseley, 1876, has five cycles of septa. *Deltocyathus rotulus* is distinguished from *D. magnificus* by having a scalloped calicular edge and in lacking the V-shaped deltoid septal fusions characteristic of the genus.

Distribution

Indian Ocean: off Durban, South Africa; off south-eastern Mozambique; off Zanzibar, Tanzania (Gardiner & Waugh 1938); Gulf of Aden (Gardiner & Waugh 1938); Maldiv Islands (Alcock 1898; Gardiner & Waugh 1938); off Sri Lanka (Van der Horst 1931); 510–1 986 m. Elsewhere: Flores Sea; 794 m (Alcock 1902a, 1902c).

Deltocyathus sp. A

Fig. 5G–H

?*Deltocyathus italicus*: Zibrowius, 1974a: 757.

Deltocyathus lens: Gardiner & Waugh, 1938: 198.

Records

V–2662, 9, IOM; MN–ZV5, 1, USNM 91551.

Remarks

This species is similar to the Miocene *D. italicus* (Michelotti, 1838) and Recent Atlantic specimens described by Cairns (1979) as *Deltocyathus* sp. cf. *D. italicus* [cited by Zibrowius (1980) and Zibrowius & Gili (1990) as *D. conicus* Zibrowius, 1980]. *Deltocyathus italicus* and the south-west Indian Ocean specimens are similar in size and shape, having a highly conical corallum with a pointed base; however, *Deltocyathus* sp. A differs in having granular, rounded costae (not dentate, ridged costae as in *D. italicus*); relatively small P₃ not fused to their corresponding S₃ (in *D. italicus*, P₃

are quite large and solidly fuse to their S_3); and a fossa moderate in depth (the central calice of *D. italicus* is usually elevated, having no fossa). Although not described or illustrated, it is likely that Zibrowius' (1974a) 'conical species' from north-west of Madagascar is the same. No other Indian Ocean species of *Deltocyathus* is known to have a conical corallum.

Distribution

Known only from the Indian Ocean off Durban, South Africa; off Zanzibar (Gardiner & Waugh 1938); ?off south-western and north-western Madagascar (Zibrowius 1974a); 207–315 m.

Genus *Desmophyllum*

Desmophyllum cristagalli Milne Edwards & Haime, 1848a

Desmophyllum cristagalli Milne Edwards & Haime, 1848a: 253, pl. 7 (fig. 10, 10a). Zibrowius, 1974a: 758–761, pl. 3 (figs 1–10); 1980: 117–121, pl. 61 (figs A–O). Cairns, 1979: 117–119, pl. 21 (figs 7–8), pl. 22 (fig. 8) [synonymy]. Zibrowius & Gili, 1990: 35–36.

Desmophyllum capense Gardiner, 1904: 96–97.

?*Desmophyllum* sp. Gardiner & Waugh, 1938: 176.

Non *Desmophyllum cristagalli* Milne Edwards & Haime. Boshoff, 1981: 37.

New records

V-2699, 1 IOM; V-2716, 6, IOM; V-2722, 1, IOM.

Distribution

Indian Ocean: off Cape of Good Hope (Gardiner 1904); off Pemba, Tanzania (Gardiner & Waugh 1938); off Walters Shoal, Madagascar Plateau; Gulf of Aden (Gardiner & Waugh 1938); Maldives Islands (Gardiner & Waugh 1938); 81–2 000 m. Elsewhere: cosmopolitan; 60–2 460 m (Cairns 1979).

Genus *Conotrochus*

Conotrochus brunneus (Moseley, 1881)

Fig. 4F–G

Pleurocyathus brunneus Moseley, 1881: 159–160, pl. 2 (fig. 1a–c).

Phloeocyathus hospes: Alcock, 1902b: 116–117.

Ceratotrochus (*Phloeocyathus*) *hospes*: Alcock, 1902c: 12, pl. 2 (fig. 8, 8a).

Conotrochus brunneus: Gardiner & Waugh, 1938: 175–176, pl. 5 (figs 11–12). Zibrowius, 1980: 79. Cairns & Parker, 1992: 22.

New record

AB-365D, 2, USNM 91556.

Distribution

Indian Ocean: off south-west Madagascar; Maldives Islands (Gardiner & Waugh 1938); 475–695 m. Elsewhere: Indonesia (Moseley 1881; Alcock 1902b, 1902c); 110–1 089 m.

Genus *Aulocyathus**Aulocyathus recidivus* (Dennant, 1906)

Fig. 5C

Ceratotrochus recidivus Dennant, 1906: 159–160, pl. 6 (figs 1a–b, 2a–c). Zibrowius, 1980: 107.*Aulocyathus recidivus*: Cairns, 1982: 25–26, pl. 7 (figs 7–9), pl. 8 (fig. 1). Cairns & Parker, 1992: 22–24, pl. 6 (figs d, h) [synonymy].*New record*Unspecified R.V. *Anton Bruun* station ‘off Madagascar’, depth unknown, 1, USNM 91555.*Remarks**Aulocyathus recidivus* is distinguished from *A. juvenescens* by its much larger and stouter corallum and by having a greater number of septa. Three additional species are known in this genus from the eastern Atlantic and western Pacific (see Zibrowius 1980).*Distribution*

Indian Ocean: ‘off Madagascar’; depth unknown. Elsewhere: off South Australia and Tasmania (Dennant 1906; Cairns & Parker 1992); Macquarie Ridge (Cairns 1982); 128–1 000 m.

Aulocyathus juvenescens von Marenzeller, 1904*Aulocyathus juvenescens* von Marenzeller, 1904: 301–302, pl. 18 (fig. 17). Zibrowius, 1980: 107.*New record**Manihine* 381–3, 2, USNM 91554. Reference material: syntypes of *A. juvenescens* from *Valdivia*–243 and 245 (ZMB 5064, 7032).*Remarks*The *Manihine* specimens, collected only several kilometres from the type locality (*Valdivia* station 245), are the only specimens to have been reported subsequent to its description in 1904.*Distribution*

Known only from the Indian Ocean off Pemba and Zanzibar, Tanzania (Von Marenzeller 1904); 302–463 m.

Genus *Dasmosmilia**Dasmosmilia variegata* (Pourtalès, 1871)

Fig. 6C

Parasmilia variegata Pourtalès, 1871: 21, pl. 1 (fig. 13).Non *Dasmosmilia variegata*: Gardiner & Waugh, 1938: 172–173.*Dasmosmilia variegata*: Cairns, 1979: 134–135, pl. 25 (figs 4–7, 10), pl. 26 (fig. 1) [synonymy]. Zibrowius, 1980: 71–72, pl. 30 (figs A–K) [synonymy].

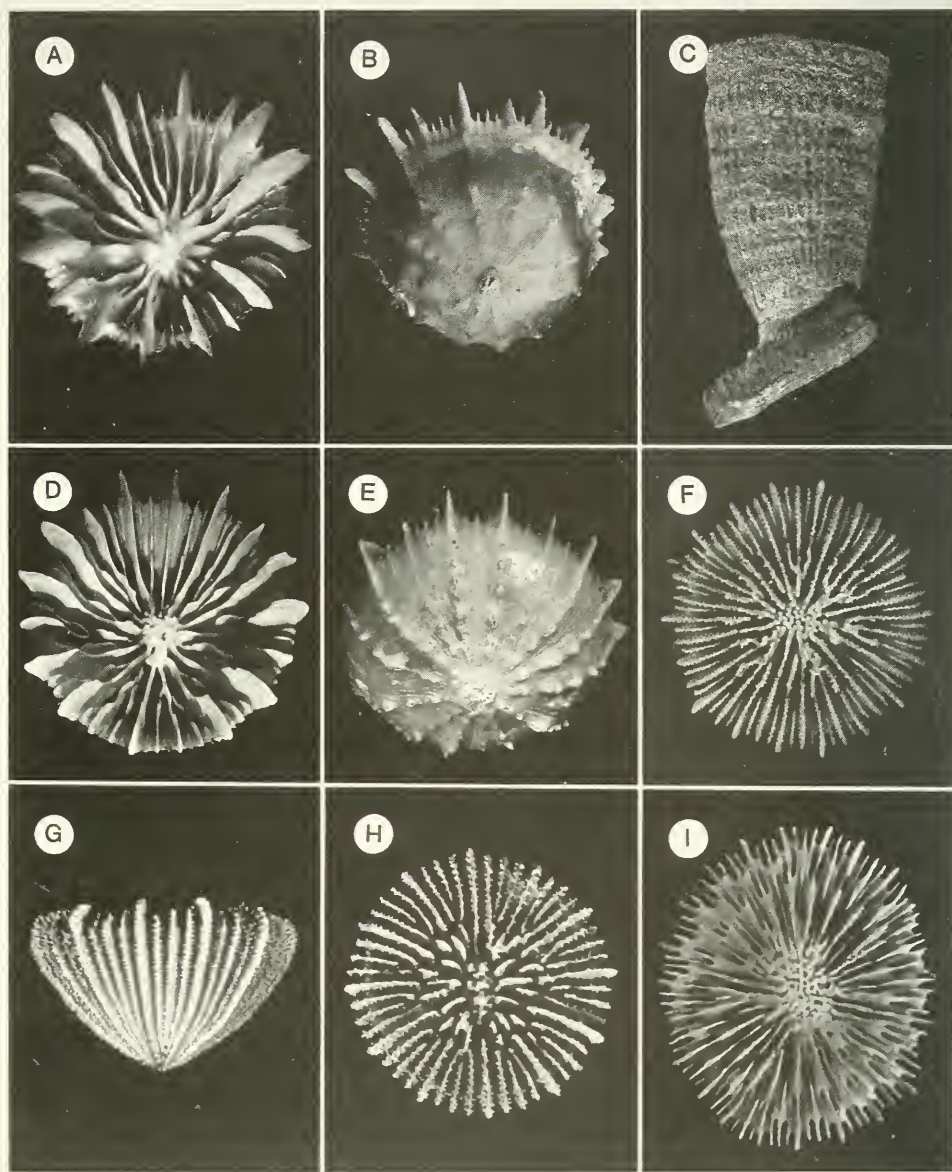


Fig. 5. A-B. *Stephanocyathus campaniformis*, V-2673, IOM, calicular and basal views. Both $\times 1.7$. C. *Aulocyathus recidivus*, Anton Bruun station 'off Madagascar', USNM 91555, lateral view. $\times 2.9$. D-E. *Stephanocyathus nobilis*, AB-399C, USNM 91545, calicular and lateral views. Both $\times 1.5$. F. *Deltocyathus andamanicus*, Manihine 381-63, USNM 91548, calice. $\times 2.2$. G-H. *Deltocyathus* sp. A, MN-ZV5, USNM 91551, calicular and lateral views. Both $\times 3.8$. I. *Deltocyathus rotulus*, AB-389C, USNM 91550, calice. $\times 1.5$.

New record

V-2644, 1, IOM.

Remarks

The figured specimen, measuring 10.1×8.3 mm in calicular diameter and 14.8 mm in height, was compared to specimens from both the western and eastern Atlantic and found to be indistinguishable in most characters, except that the Indian Ocean specimen is firmly attached to a substrate (a cylindrical bryozoan), not asexually regenerated from a parent corallum fragment, as is typical for most other known specimens.

Distribution

Indian Ocean: off south-western Madagascar; 330–335 m. Elsewhere: off Florida, Venezuela, Brazil, Cape Verde Islands, and the Azores; 110–600 m (Cairns 1979; Zibrowius 1980).

Genus *Asterosmilia**Asterosmilia marchadi* (Chevalier, 1966)

Fig. 6A–B

Ceratotrochus johnsoni: Gardiner, 1904: 118–119, pl. 1 (fig. 5a–c), pl. 2 (fig. M). Gardiner & Waugh, 1938: 188.

Dasmosmilia marchadi Chevalier, 1966: 944–949, pl. 5 (figs 3–4).

Asterosmilia marchadi: Cairns, 1979: 140–142, pl. 26 (figs 7, 9–10). Zibrowius, 1980: 141–142, pl. 74 (figs A–K) [synonymy].

New records

V-2634, 1, IOM; AB-372J, 2, USNM 91557; AB-372L, 26, USNM 91559, 1, SAM-H4594; AB-373B, 1, USNM 91560; MN-ZD8, 1, USNM 91561; MN-ZH27, 1, USNM 91562. Reference specimens: *C. johnsoni* of Gardiner & Waugh (1938): JM-106, 2, BM 1950.1.9.1065–1069; JM107, 1, BM 1950.1.9.1284; *C. johnsoni* of Gardiner (1904) from Cape Natal, 1, BM 1950.1.10.118.

Remarks

Zibrowius (1980: 141, 142) noted the extreme resemblance of the Indian Ocean specimens reported by Gardiner (1904) and Gardiner & Waugh (1938) to Atlantic *A. marchadi*, but did not commit to that identification. Comparisons of the south-west Indian Ocean specimens reported herein and Gardiner (1904) and Gardiner & Waugh's (1938) specimens, with typical eastern and western Atlantic specimens of *A. marchadi*, show no significant differences. Therefore, *A. marchadi* is considered to have a disjunct distribution in both the Atlantic and western Indian oceans.

Distribution

Indian Ocean: South Africa off Bisho, Cape Natal (Gardiner 1904), and Zululand; off south-eastern Mozambique; off Pemba, Tanzania (Gardiner & Waugh 1938); off the Maldive Islands (Gardiner & Waugh 1938); 57–229 m. Elsewhere: eastern

Atlantic from Spanish Sahara to Gabon (Zibrowius 1980); western Atlantic from off Florida and the northern coast of South America (Cairns 1979); 79–229 m.

Genus *Solenosmilia*

Solenosmilia variabilis Duncan, 1873

Fig. 6D

Solenosmilia variabilis Duncan, 1873: 328, pl. 42 (figs 11–18). Von Marenzeller, 1904: 310–311, pl. 15 (fig. 4, 4a). Zibrowius, 1974a: 768–769; 1980: 143–145, pl. 75 (figs A–N) [synonymy]. Cairns, 1979: 136–138, pl. 26 (figs 2–4) [synonymy]. Scheer & Pillai, 1983: 160. Cairns & Parker, 1992: 29–30, pl. 8 (figs d–e).

Solenosmilia jeffreyi Alcock, 1898: 27–28, pl. 3 (fig. 3, 3a–b).

Non *Solenosmilia variabilis* Duncan. Gardiner & Waugh, 1939: 229–230.

New records

MN–SM129, 1 branch, USNM 77211; MN–SM162, 2 colonies, USNM 91690; MN–SM226, branch fragments, USNM 91691.

Distribution

Indian Ocean: off South Africa from Agulhas Bank (Von Marenzeller 1904) to off Durban; off Somalia (Von Marenzeller 1904); Laccadive Sea (Alcock 1898); 366–1 079 m. Elsewhere: ampho-Atlantic; South Australia; circum-Subantarctic; 220–2 165 m (Cairns & Parker 1992).

Genus *Goniocorella*

Goniocorella dumosa (Alcock, 1902c)

Fig. 6E

Pourtalesmilia dumosa Alcock, 1902c: 36–37, pl. 5 (fig. 33, 33a).

Goniocorella dumosa: Cairns, 1982: 31–34, pl. 9 (figs 7–9), pl. 10 (figs 1–2) [synonymy].

New record

MN–SM174, 4 branches, USNM 77221.

Distribution

Indian Ocean: off Bisho, South Africa; 760 m. Elsewhere: off Japan, Banda Sea, and New Zealand region; 100–638 m (Cairns 1982).

Genus *Rhizosmilia*

Rhizosmilia robusta sp. nov.

Fig. 6F–I

Records

Holotype: AB–373B, 1, USNM 91681. Paratypes: AB–371F, 1, USNM 91682; AB–408D, 2 corallites, USNM 91683; MN–ZB23, 1, SAM–H4572; MN–ZC10, 1,

USNM 91684; MN-ZD5, 1, USNM 91685; MN-ZDD3, 3, USNM 91689; MN-ZD7, 2, USNM 91686, 1, SAM-H4573; MN-ZK20, 1, USNM 91687; MN-ZK21, 1, USNM 91688.

Description

Corallites trochoid in shape, firmly attached through a massive pedicel and thin expansive base. Largest corallite of holotypic colony $31,0 \times 26,2$ mm in calicular diameter, 25,0 mm in height, and 16,8 mm in pedicel diameter. Lower pedicel and base reinforced with concentric rings of hollow chambers formed by adding exothecal dissepiments over raised costae (Fig. 6G), as is characteristic of the genus (Cairns 1978). Calice elliptical in outline, even in small specimens. Costae equal (0,4–0,5 mm wide) and quite low, separated by very narrow (0,10–0,12 mm), shallow intercostal striae. Costae covered with low, rounded granules. Corallum white.

Septa arranged in five cycles according to the formula: $S_1 > S_2 > S_3 > S_4 > S_5$, the fourth cycle complete at a GCD of 8–9 mm and the fifth cycle complete at a GCD of 19–21 mm; S_6 not observed even in largest calice of 31 mm diameter. S_1 moderately exsert (up to 2,7 mm above calicular edge), their inner edges vertical and straight, extending to the columella. Septa of higher cycles progressively less exsert and smaller, except for those S_5 adjacent to S_1 , which are more exsert than their adjacent S_4 . Inner edges of S_2 also straight; inner edges of S_3 and S_4 slightly sinuous; S_5 rudimentary, with irregularly shaped inner edges. Septal faces relatively smooth, bearing very low and sparsely placed granules. Septa well spaced, each separated from one another by approximately twice the septal thickness. Small paliform lobes present deep in fossa before septa of penultimate cycle (P_4 , if S_5 present; P_3 , if only S_4 present in a half-system) and in such a manner of insertion as described by Cairns (1978) for *R. gerdae*. Paliform lobes sometimes dissected into three or four thin, elongate ribbons, similar in shape to columellar elements, but occurring higher in fossa.

Fossa deep, containing a trabecular columella. Vescicular endothecal dissepiments present, giving corallum a low density.

Remarks

Although the holotype is a phaceloid colony of four corallites, all paratypes are represented as individual corallites, either broken from a larger colony or not yet having formed a colony.

Only two other species of *Rhizosmilia* are known: *R. maculata* (Pourtales, 1874) and *R. gerdae* Cairns, 1978, both species known only from relatively shallow water (3–287 m) in the western Atlantic. *Rhizosmilia robusta* sp. nov. is most similar to *R. maculata*, especially in corallum size and shape and septal, palar, and costal morphology, but differs in having an entirely white corallum (that of *R. maculata* is speckled brown), and in having fewer septa at a corresponding calicular diameter. *Rhizosmilia robusta* attains its fifth cycle at a GCD of 19–21 mm, whereas *R. maculata* attains its at a GCD of only 11 mm (Cairns 1977) and often has additional S_6 in larger corallites.

A probable fourth species of *Rhizosmilia* was reported as *Caryophyllia gigas* by Van der Horst (1931) from off Mauritius—*Rhizosmilia gigas* comb. nov. Because only

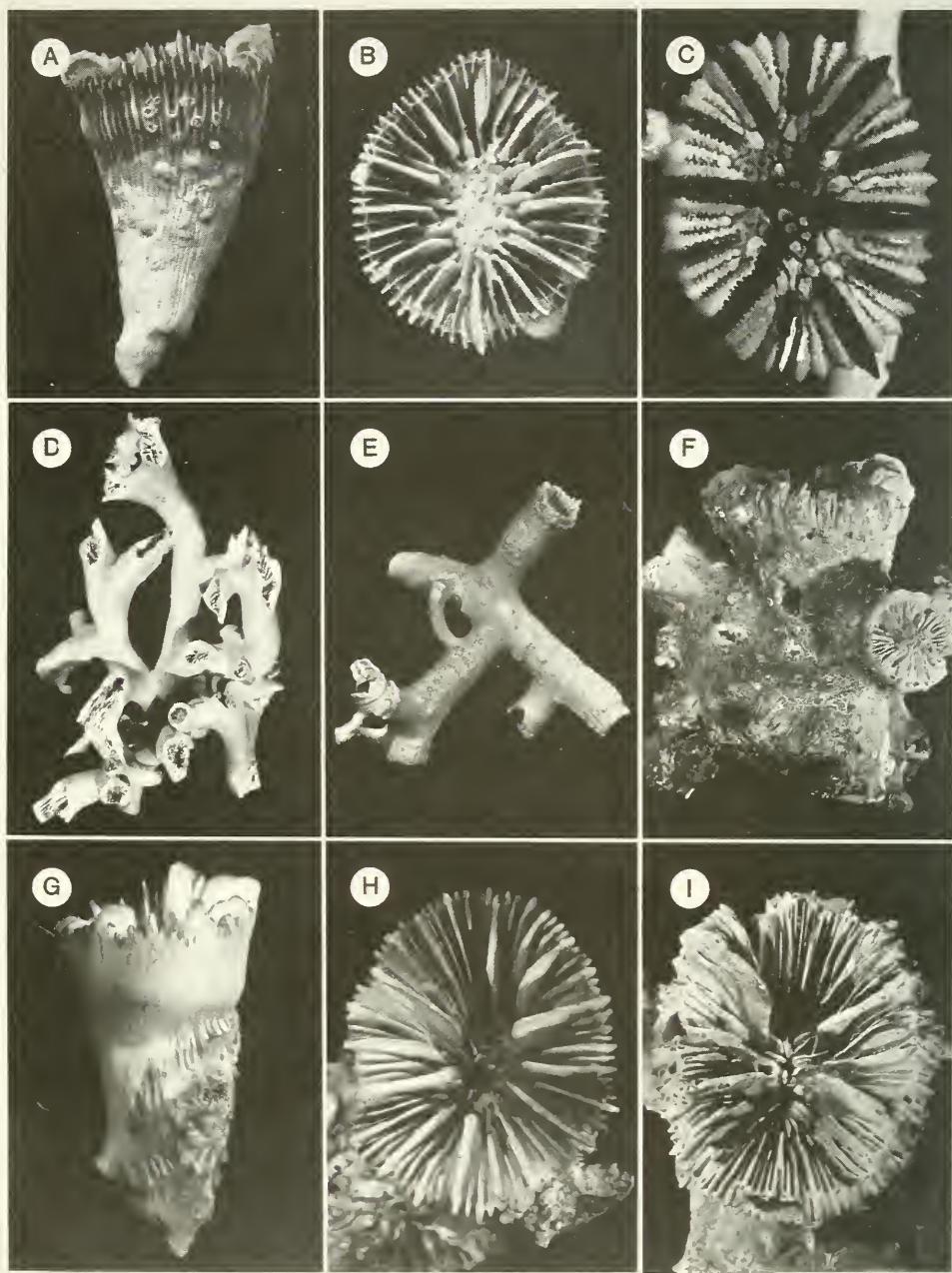


Fig. 6. A-B. *Asterosmilia marchadi*, V-2634, IOM, lateral and calicular views. A $\times 1,5$, B $\times 2,1$. C. *Dasmosmilia variegata*, V-2644, IOM, calice. $\times 4,7$. D. *Solenosmilia variabilis*, MN-SM162, USNM 91690, partial colony. $\times 0,7$. E. *Goniocorella dumosa*, MN-SM174, USNM 77221. $\times 1,6$. F-I. *Rhizosmilia robusta* sp. nov. F, I. AB-373B (holotype), lateral and calicular views. F $\times 0,9$, I $\times 1,5$. G. MN-ZD7, USNM 91686, paratype illustrating exothecal roots. $\times 2,5$. H. MN-ZD5, USNM 91685, calice of a paratype. $\times 2,2$.

the holotype is known, which has a broken base, the colonial nature of the species is unknown, but the arrangement of paliform lobes (P4), endothecal dissepiments, and epithecal rootlets at the broken pedicel, suggest a placement in *Rhizosmilia*. The holotype is deposited at the BM (1939.7.20.851).

Etymology

The species name *robusta* (from the Latin *robustus*, hard, strong, like oak) is an allusion to the thick pedicels of this species, which contribute to a robust colony.

Distribution

Off Zululand, South Africa; off south-eastern Mozambique; Mozambique Channel off Madagascar; 66–150 m. Type locality: 26°00'S 33°05'E (off south-eastern Mozambique), 135 m.

Family Turbinoliidae Genus *Tropidocyathus*

Tropidocyathus lessoni (Michelin, 1842)

Fig. 7C

Flabellum lessoni Michelin, 1842: 119.

Tropidocyathus lessoni: Gardiner & Waugh, 1938: 194. Cairns, 1989b: 33–34, pl. 16 (figs d–l) [synonymy].

New records

MN-ZA51, 1, USNM 91692; MN-ZB24, 1, USNM 91693; MN-ZD4, 1, USNM 91694; MN-ZD6, 2, USNM 91695; MN-ZD7, 4, USNM 91696; MN-ZD8, 6, USNM 91697, 1, SAM-H4583; MN-ZDD3, 4 USNM 91706; MN-ZDD4, 7, USNM 91707, 2, SAM-H4588; MN-ZDD7, 1, USNM 91708; MN-ZH18, 1, USNM 91698; MN-ZH19, 1, USNM 91699; MN-ZH23, 4, USNM 91700; MN-ZH26, 3, USNM 91701; MN-ZK20, 1, USNM 91702; MN-ZK25, 1, USNM 91703; MN-ZV20, 2, USNM 91704; MN-ZV21, 3, USNM 91705.

Remarks

This is a commonly collected south-west Indian Ocean shallow-water azooxanthellate solitary coral, easily distinguished from all other species by its pale-orange corallum and prominent thecal edge crests. *Endopachys grayi* also has edge crests but always has a white corallum, the characteristic porous dendrophylliid theca, and a Pourtales Plan.

Distribution

Indian Ocean: South Africa from off Natal to Zululand; off south-eastern Mozambique (Cairns 1989b); off Zanzibar, Tanzania (Gardiner & Waugh 1938); off Kenya and north-eastern Somalia (Cairns 1989b); 62–155 m. Elsewhere: western Pacific from East China Sea to Indonesia; 68–421 m (Cairns 1989b).

Genus *Thrypticotrochus**Thrypticotrochus multilobatus* Cairns, 1989b

Fig. 7F, I

Thrypticotrochus multilobatus Cairns, 1989b: 37, pl. 19 (figs b–g).*New records*

AB-365D, 3, USNM 91709; AB-370G, 2, USNM 91710; AB-399A, 1, USNM (lost).

Remarks

All specimens were asexually regenerated from parent fragments, the largest corallum 4,4 mm in calicular diameter.

Distribution

Indian Ocean: off south-western Madagascar; off south-eastern Mozambique; 347–925 m. Elsewhere: South China Sea; Philippines; off south-eastern Australia (Cairns 1989b); 130–507 m.

Genus *Sphenotrochus*KEY TO THE SOUTH-WEST INDIAN OCEAN SPECIES OF *SPHENOTROCHUS*

- 1A. Each costa composed of a single, elongate ridge 2
- 1B. Each costa composed of two or more irregular rows of short, narrow ridges
..... *S. gilchristi* Gardiner, 1904
- 2A. Corallum cuneiform but full (appears swollen); full fourth cycle (48) of costae present; columella massive, rising well above upper septal edges
..... *S. aurantiacus* von Marenzeller, 1904
- 2B. Corallum cuneiform but compressed; only four pairs of C₄ present in end half-systems (total = 32); columella only as thick as an S₁ and not as exsert as an S₁ 3
- 3A. Costae rounded, equal in width, and do not overlap adjacent costae; intercostal striae broad (35–55 % width of a costa); corallum triangular, faces diverging at a constant angle from base *S. evexicostatus* sp. nov.
- 3B. Costae flattened, unequal in width, and overlapping adjacent costae; intercostal striae narrow (only 8–18 % width of a costa); corallum roughly rectangular and more highly compressed basally *S. imbricaticostatus* sp. nov.

Sphenotrochus (*S.*) *aurantiacus* von Marenzeller, 1904

Fig. 6D–E, G–H

Sphenotrochus aurantiacus von Marenzeller, 1904: 280–281, pl. 18 (fig. 15). Wells, 1935: 531.
?Boshoff, 1981: 38–39. Cairns, 1989b: 38.

New records

AB-358A, 13, USNM 77185, 1. SAM-H4589, 1, NM; AB-358C, 2, USNM 77182; MN-ZM8, 1, USNM 91719; 2 syntypes of *Sphenotrochus aurantiacus* examined from Valdivia-104, ZMB 5095.

Distribution

Agulhas Bank (Von Marenzeller 1904); off Durban and Zululand, South Africa; ?off south-eastern Mozambique (Boshoff 1981); 155–366 m. Bathymetric ranges of Boshoff's specimens not included because his specimens represent a mixed lot of two, if not three, species.

Sphenotrochus (S.) evexicostatus sp. nov.

Fig. 8A–H

?*Sphenotrochus intermedius*: Macnae & Kalk, 1958: 123.

?*Sphenotrochus* sp. Pichon, 1974: 176, text-fig. 5.

Sphenotrochus aurantiacus: Boshoff, 1981: 38–39 [part.—3 specimens from off Inhaca, 12 m].

Records

Holotype: AB–372B, 1, USNM 77186. Paratypes: AB–371G, 3, USNM 77194; AB–372B, 43, USNM 91712, 1, SAM–H4584; AB–391J, 6, USNM 77184; AB–392J, 12, USNM 77188; off Inhaca, 12.2 m, 3, USNM 77190.

Description

Corallum medium in size for the genus, the holotype measuring 5.25×3.20 mm in calicular diameter and 7.88 mm in height, but larger specimens up to 10.6 mm in height present in type series. Corallum cuneiform, the flat corallum faces diverging at a constant angle of about 12° . Viewed from the side, the corallum is triangular with a gently rounded base. Costae equal in width (0.15–0.17 mm), rounded, and smooth, only the principal C_1 and their adjacent C_4 being somewhat granular (Fig. 8H). Most costae continuous from calice to about 1.5 mm from base, where they either terminate or transform into discontinuous ridges. Costae usually not vertical in arrangement, but slanted inward toward the sand-grain substrate incorporated into its base. Intercostal striae broad and open, about 0.06–0.10 mm wide, or 35–55 per cent width of a costa, affording an easy view of underlying corallum theca (Fig. 8D–E). Freshly preserved coralla light yellow to brown.

Septa hexamerally arranged in three cycles. Pairs of C_4 occur in each half-system adjacent to the two principal septa (total = 32 costae), but rarely in half-systems beyond these, but septa (S_4) do not correspond to these costae. S_1 and S_2 equal in size, moderately exsert, and extend about three-quarters distance to columella, merging with columella only lower in fossa. Inner edges of S_1 and S_2 slightly sinuous. S_3 slightly less exsert and only about one-third width of S_1 and S_2 . Septa and columella bear low, inconspicuous granules, producing relatively smooth faces.

Columella a solid, sharp-edged lamella rising almost to height of exsert septa, and of equal thickness to an S_1 (i.e. 0.15–0.16 mm).

Remarks

Although *S. evexicostatus* sp. nov. is of approximately the same size as *S. imbricatocostatus* sp. nov., has the same arrangement of septa and costae, similar columella, and they are often found living together, *S. evexicostatus* is distinguished by its rounded, non-imbricate costae of equal width, wider intercostal striae, smaller S_3 in relation to the S_1 and S_2 , and smoother septal and columellar faces. *Sphenotrochus*

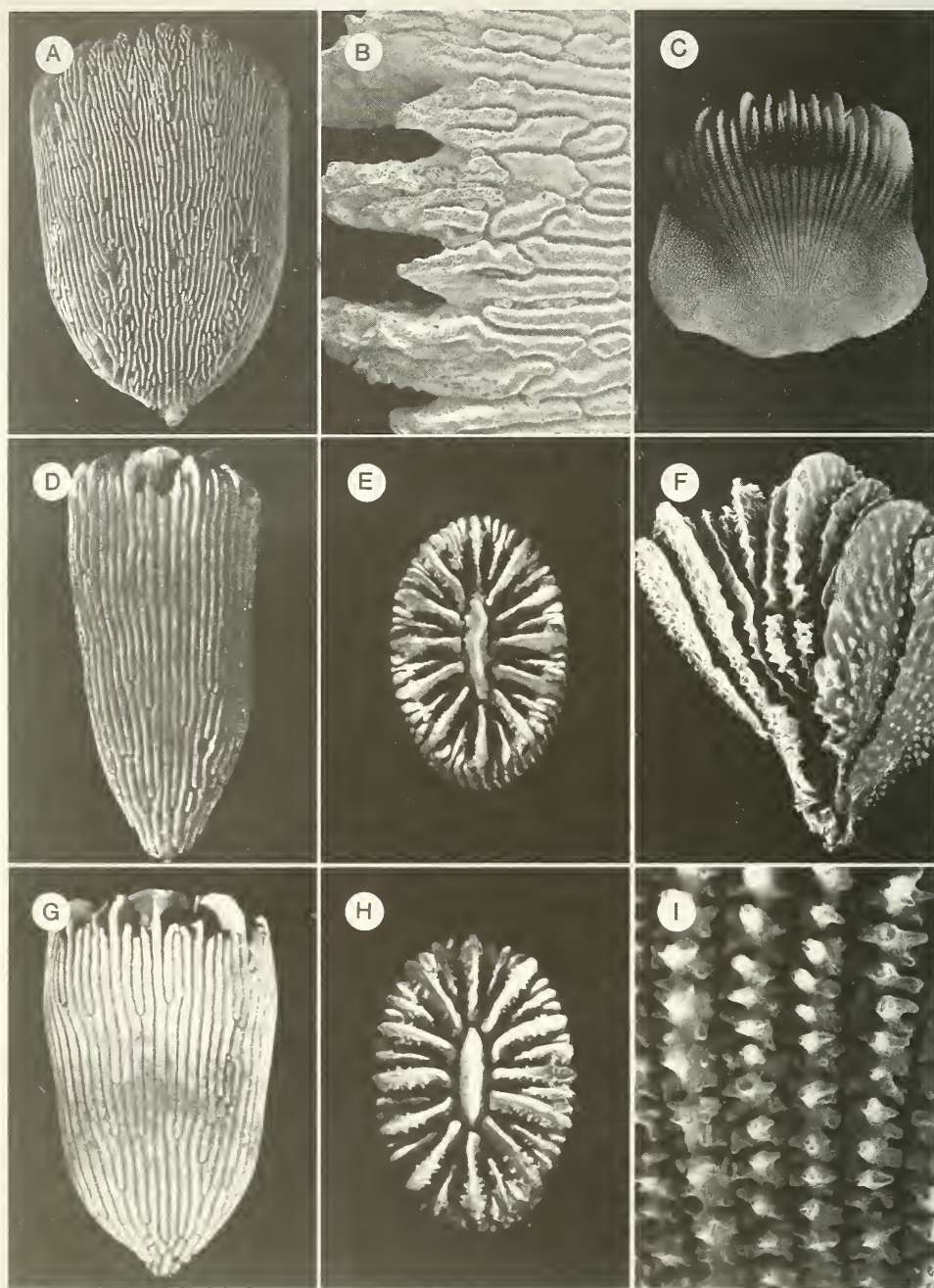


Fig. 7. A-B. *Sphenotrochus gilchristi*. A. *S. dentosus* (*nomen nudum*) of Boshoff (1981), South Africa, South African Museum. B. *Vema* 19-28, USNM 87610, costal granulations near calice. $\times 24$. C. *Tropidocyathus lessoni*, MN-ZH18, USNM 91698, lateral view showing alate end costae. $\times 2.5$. D-E. G-H. *Sphenotrochus aurantiacus*. D-E. Syntype from *Valdivia*-104, ZMB 5095, lateral and calicular views. D $\times 6.6$, E $\times 10$. G-H. AB-358A, USNM 77185, lateral and calicular views. G $\times 6.2$, H $\times 8.0$. F, I. *Thrypticotrochus multilobatus*, AB-365D, USNM 91709, corallum fragment. $\times 10.5$, and enlargement of costae. $\times 35$.

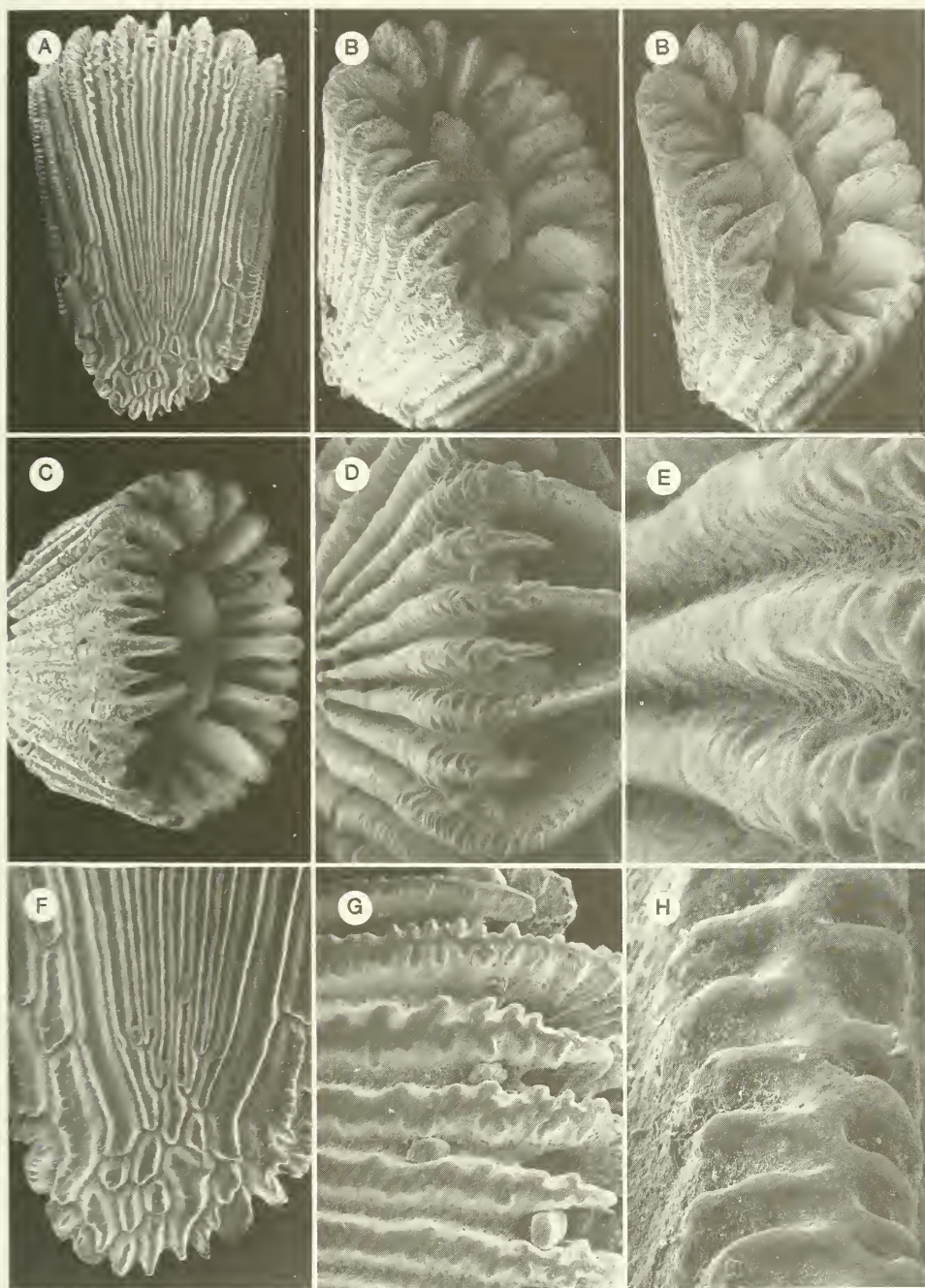


Fig. 8. A-H. *Sphenotrochus evexicostatus* sp. nov. (B-C, holotype; A, D-H, paratype from AB-392J). A. Lateral view of corallum. $\times 9,0$. B. Stereo view of calice. $\times 11$. C. Oblique view of calice. $\times 10$. D-E. Longitudinal views of costae showing broad intercostal furrows and rounded costae. D $\times 24$, E $\times 71$. F-G. Costal details at corallum base and near calice. F $\times 16$, G $\times 32$. H. Granulated edge costa. $\times 175$.

evexicostatus sp. nov. bears some resemblance to *S. andrewianus* Milne Edwards & Haime, 1848 (eastern Atlantic, 12–105 m), in size and shape, but differs in having some pairs of C_4 , a more compressed corallum, and a consistently lamellar columella.

Etymology

The species name *evexicostatus* (from the Latin *evexus*, rounded at the top + *costatus*, having rib-like ridges) refers to the costae of this species, which are evenly rounded on top.

Distribution

Off South Africa from Durban to south-eastern Mozambique; ?off Madagascar (Pichon 1974); 12,2–73 m. Type locality: 24°48'S 34°59'E (off south-eastern Mozambique), 42 m.

Sphenotrochus (*S.*) *imbricaticostatus* sp. nov.

Fig. 9A–H

Sphenotrochus aurantiacus: Boshoff, 1981: 38–39 [*part.* — 9 specimens from off Inhaca, 12,2 m].

Records

Holotype: MN-ZB27, 1, USNM 91715. Paratypes: AB-370G, 12, USNM 77183; AB-370H, 21, USNM 77181; AB-372B, 36, USNM 91716, 2, SAM-H4586; AB-372L, 29, USNM 77187; AB-372P, 20, USNM 77189; AB-391J, 2, USNM 91717; AB-392J, 7, USNM 91718; Inhaca, Mozambique, 12,2 m, 9, USNM 77190, and 24, currently deposited at Station Marine d'Endoume, Marseille.

Description

Corallum small, largest specimen (holotype) only $3,68 \times 2,47$ mm in calicular diameter and 6,55 mm in height. Corallum cuneiform: highly compressed in lower corallum where opposite faces are essentially parallel; upper corallum slightly flared. Viewed from the side, corallum is often rectangular (Fig. 9A, C), with only a slight rounding of the basal edges. Costae smooth, flat, and oriented vertically, most continuous from calice to base. In well-preserved coralla, 12–14 costae slightly overreach the base and meet their counterparts from the opposite face. Costae alternate in width near calicular edge, C_3 (0,30–0,35 mm wide) being broader than the C_1 and C_2 (0,14–0,18 mm wide, Fig. 9F–G). Intercostal striae narrow (0,030–0,035 mm wide), or only 8–18 per cent of costal width, not affording a view of underlying theca. Each costa has a thin (0,018–0,020 mm) lateral extension (Fig. 9G), which overlaps the extension of its two adjacent costae in alternating fashion such that the C_3 extensions are invariably higher than those of the C_1 and C_2 near the calicular edge. Lower on theca, the situation is reversed. These lateral costal extensions are particularly broad (up to 0,1 mm) on the lower, outer edges of the four C_2 near the principal C_1 and their adjacent C_4 near the base of the corallum (Fig. 9H). Colour of a fresh corallum light brown; theca procyanaceous.

Septa hexamerally arranged in three complete cycles (24 septa). Pairs of C_4 occur in each half-system adjacent to the two principal S_1 (total = 32 costae), but S_4 do not correspond to them inside calice. S_1 and S_2 equal in size, moderately exsert, and

extend about four-fifths distance to columella, joining with columella only lower in fossa. Inner edges of S_1 and S_2 slightly thickened. S_3 equally exsert but only three-quarters as wide as S_1 and S_2 . All septa, as well as columella, covered with tall (up to 0,060 mm), slender spines.

Columella a solid, sharp-edged lamella rising almost to height of exsert septa, equal to or slightly thicker (about 0,1 mm) than S_1 and S_2 . Viewed from the side, the columella is rectangular.

Remarks

Sphenotrochus imbricaticostatus sp. nov. is distinguished from the nine other Recent species in the genus (eight listed by Cairns 1989b: 38, plus *S. evexicostatus* sp. nov.) by its extremely compressed rectangular-cuneiform corallum and its wide, flat costae, which alternate in width and imbricate with edges of adjacent costae.

Etymology

The species name *imbricaticostatus* (from the Latin *imbricatus*, overlapping + *costatus*, having rib-like ridges) is an allusion to the distinctive imbricate costae of this species.

Distribution

Off Durban, South Africa to south-eastern Mozambique; 37–347 m. Type locality: 27°03,9'S 32°53,0'E (off Zululand, South Africa), 44 m.

Sphenotrochus (Eusthenotrochus) gilchristi Gardiner, 1904

Fig. 7A–B

Sphenotrochus gilchristi Gardiner, 1904: 98–99, pl. 1 (figs a–g). Zibrowius & Gili, 1990: 44.

Eusthenotrochus moseri Wells, 1935: 530–532, pl. 18 (figs 5–6).

Sphenotrochus dentosus Boshoff, 1981: 39 (*nomen nudum*).

Sphenotrochus sp. (*incertae sedis*) Boshoff, 1981: 39 [= *S. 'dentosus'*].

New records

AB–358A, 3, USNM 77191; AB–392J, 2, USNM 77192; *Vema* 19–28, 1, USNM 87610; *Sardinops* CD32, 1, USNM 91714, 1, SAM–H4590.

Remarks

Three specimens identified as *S. dentosus* by Boshoff (1981) were borrowed from the ORI and found to be typical *S. gilchristi*.

Distribution

Agulhas Bank (Wells 1935); off Durban and Simon's Town; 24–165 m.

Genus *Peponocyathus*

Peponocyathus australiensis (Duncan, 1870)

Deltocyathus italicus var. *australiensis* Duncan, 1870: 297.

Deltocyathus minutus Gardiner & Waugh, 1938: 198, text-fig. 15. Scheer & Pillai, 1983: 156.

Peponocyathus australiensis: Cairns, 1989b: 30–32, pl. 14 (figs d–j), pl. 15 (figs a–d) [synonymy].

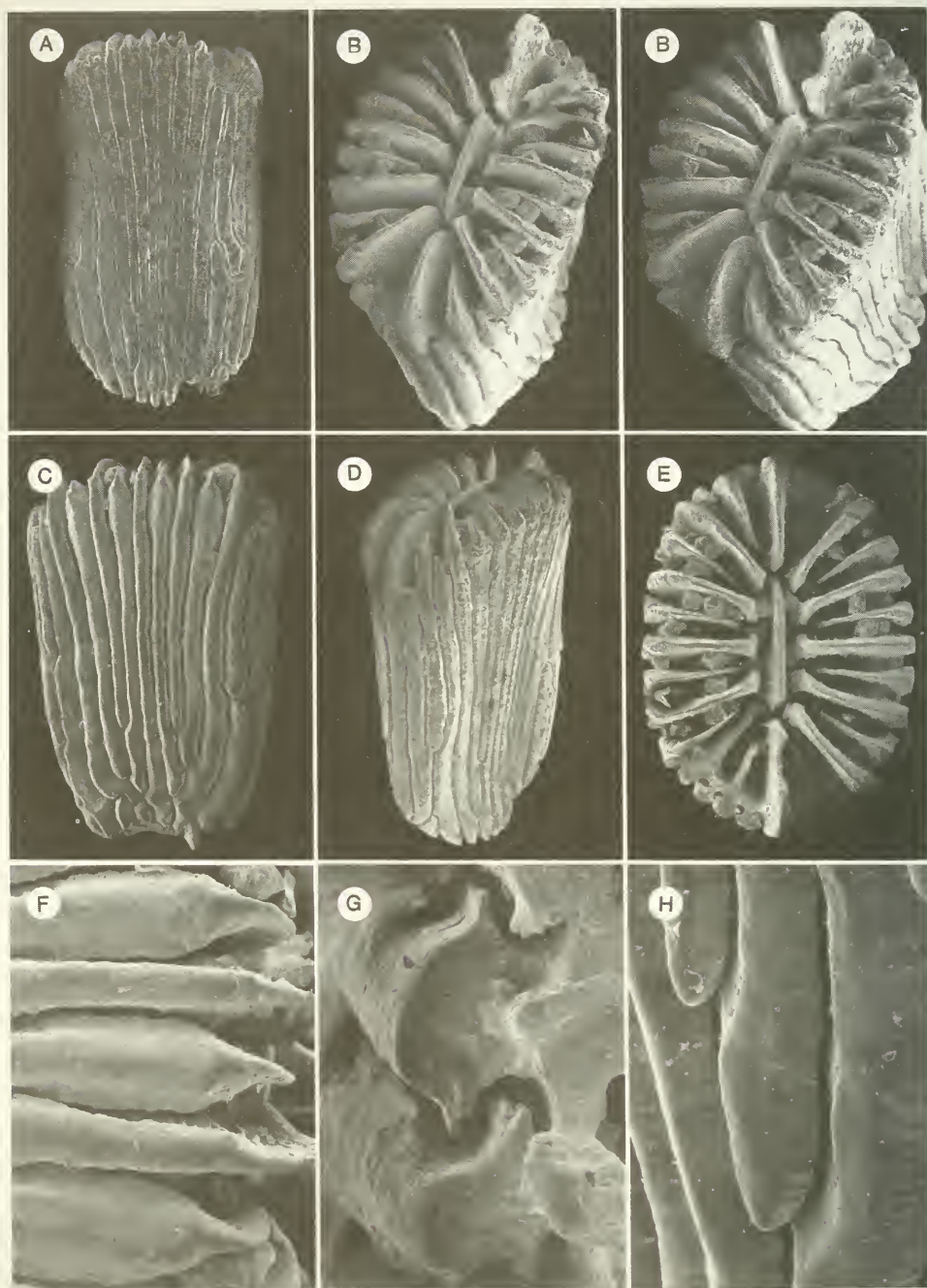


Fig. 9. A-H. *Sphenotrochus imbraticostatus* sp. nov. (A-B, D-E, holotype; C, F-H, paratypes from AB-372P). A, C. Lateral views. A $\times 8.3$, C $\times 11$. B. Stereo view of calice at oblique angle, $\times 14.5$. D. Oblique lateral view of corallum, $\times 9.7$. E. Calicular view, $\times 15.5$. F-G. Imbricate costae near calicular edge (exterior and cross sectional views). F $\times 41$, G $\times 110$. H. Imbricate costae near corallum base $\times 60$.

New record

AB-390S, 2, USNM 91711.

Distribution

Indian Ocean: off Natal, South Africa; off Zanzibar, Tanzania (Gardiner & Waugh 1938); Red Sea (Gardiner & Waugh 1938); 101–366 m. Elsewhere: widely distributed in Atlantic and Indo-West Pacific; 44–635 m (Cairns 1989*b*).

Family **Flabellidae**Genus *Flabellum**Flabellum (Ulocyathus) japonicum bythios* subsp. nov.

Fig. 10A–B

Flabellum japonicum Wood Mason & Alcock, 1891*a*: 449–450. Alcock, 1898: 23. Gardiner, 1929: 306–308, pl. 13 (figs 1–6) [*part.*—not station 242].

Flabellum apertum: Keller, 1974: 205–208 [*part.*—V-4620, pl. 6 (figs 6–7)].

Flabellum japonicum sensu Alcock, 1898: Cairns, 1989*b*: 54, 56.

Records

Holotype: V-2815, 1, IOM. Paratypes: V-2653, 1, IOM; V-2814, 1, IOM; V-2815, 1, IOM; *Marion Dufresne* 27–4, 9, USNM 77203, 1, SAM-H4575; *Investigator*-133, 2, USNM 18156.

Description

Corallum elliptical in cross-section (GCD : LCD about 1,3), having a full, campanulate shape, the 12 C₁ and C₂ only slightly ridged at point of upward inflection of corallum. Corallum fragile and thus often collected damaged. Slightly damaged holotype 46,7 × 36,0 mm in calicular diameter (estimated) and slightly over 25 mm in height. Pedicel circular, about 2,5 mm in diameter. Freshly preserved coralla light reddish-brown, sometimes more intensely pigmented near thecal edges of S₁ and S₂. Lower corallum—that part probably submerged in soft substrate—usually corroded to a white or light grey colour.

Septa hexamerally arranged in five complete cycles; however, one large specimen (V-2653) of 55 mm GCD has 14 primary septa and a corresponding number of higher cycle septa for a total of 112 septa. S₁ and S₂ equal in size, their straight inner edges almost meeting in centre of fossa. S₃ about half width of S₁ and S₂; S₄ about half width of S₃; S₅ rudimentary, extending only several millimetres down thecal wall and having irregular, dentate inner edges. Calicular margins scalloped, each S₁ and S₂ and adjacent S₅ forming a triangular thecal extension about 3,5 mm tall, and each S₃ a smaller extension of about 1,5 mm in height. Inner edges of all septa straight and the septa themselves are planar; septal faces relatively smooth, covered with low, inconspicuous granules. All septa quite thin (about 0,3 mm) and well separated from adjacent septa by a distance of 4–5 septal thicknesses.

Fossa deep and elongate. Columella an elongate, concave fusion of lower, inner edges of S₁–S₃.

Remarks

Cairns (1989b: 56) suggested that the Indian Ocean specimens previously reported as *F. japonicum* (see synonymy) be considered as a new species, and listed four differences between them and typical *F. japonicum*. To reiterate, the Indian Ocean specimens have a campanulate corallum, higher thecal extensions, white coralla, and lack thecal edge crests. These differences still appear valid except for corallum colour, well-preserved Indian Ocean specimens having the same pigmentation as *F. japonicum*. However, another difference noted here is that the pedicel of *F. japonicum bythios* subsp. nov. is circular and larger than that of the typical subspecies. Gardiner (1929) noted small differences between *F. japonicum* and Indian Ocean specimens, but did not consider them to be of specific importance. Given the geographic and bathymetric isolation of the two forms (see Distribution) and the several minor but consistent morphological differences, the Indian Ocean specimens are considered to represent a subspecies of *F. japonicum*.

Etymology

The subspecies name *bythios* (from the Greek *bythios*, of the deep) is an allusion to the apparent deeper range of this subspecies than the typical subspecies.

Distribution

Off south-western Madagascar; Mascarene Plateau; Laccadive Sea (Gardiner 1929; Keller 1974); Gulf of Manaar (Gardiner 1929); Bay of Bengal (Alcock 1898; Gardiner 1929); 1 095–1 720 m. Type locality: 9°40'S 60°31'E (Mascarene Plateau), 1 520–1 720 m. Distribution of typical subspecies: off Japan; Philippines; Indonesia; 128–1 141 m (Cairns 1989b).

Flabellum (Ulocyathus) lowekeyesi Squires & Ralph, 1965

Fig. 10D–E

Flabellum lowekeyesi Squires & Ralph, 1965: 259 (figs 1–2). Squires & Keyes, 1967: 27, pl. 6 (figs 1–2). Cairns, 1989b: 54.

New records

V–2637, 1, IOM; V–2668, 11, IOM, 1, USNM 91734; V–2706, 4, IOM; V–2721, 95, IOM; V–2764, 2, IOM; V–2816, 30, IOM.

Remarks

The south-west Indian Ocean specimens are indistinguishable from typical specimens from off New Zealand.

Distribution

Indian Ocean: off south-eastern Mozambique; Mascarene Plateau; Madagascar Plateau; 835–1 030 m. Elsewhere: Campbell Plateau and off New Zealand; 278–732 m (Squires & Keyes 1967).

Flabellum (Ulocyathus) messum Alcock, 1902c

Fig. 10G-H

Flabellum laciianiatum var. *messum* Alcock, 1902c: 31.*Flabellum (U.) messum*: Cairns, 1989b: 58-59, pl. 30 (figs f-i, k) [synonymy].*New record*

V-2816, 1, USNM 91735.

Remarks

Flabellum messum is very similar to *F. lowekeyesi*, but differs in having a reddish-brown corallum; a rough, granular thecal texture; better defined thecal extensions; and independent S₄ (see also Cairns 1989b: 58).

Distribution

Indian Ocean: Mascarene Plateau; 430-835 m. Elsewhere: off Philippines (Cairns 1989b); Indonesia (Alcock 1902c); 368-949 m.

Flabellum (Flabellum) pavoninum Lesson, 1831

Flabellum pavoninum Lesson, 1831: 2. Gardiner, 1902: 123-125, pl. 4 (figs 18-21); 1904: 98. Gardiner & Waugh, 1938: 174. Zibrowius *et al.*, 1975: 98-99, pl. 2 (figs D-E). ?Boshoff, 1981: 35. Zibrowius & Grygier, 1985: 122. Cairns, 1989b: 46-50, pl. 23 (figs g-l), pl. 24 (figs a-d) [synonymy].

Flabellum pavoninum sensu Gardiner, 1902. Cairns, 1989b: 47, pl. 24 (figs g-h).

Flabellum sp. 6 Cairns, 1989a: 63, 67, text-fig. 2.

New records

V-2662, 1, IOM; V-2686, 1, IOM; V-2724, 16, IOM; V-2767, 8, IOM; V-2804, 3, IOM; AB-371E, 2, USNM 91724; AB-372L, 10, USNM 91726; AB-390S, 24, USNM 91727; AB-421G, 1, USNM 91728; *Manihine* 381-63, 1, USNM 91722; MN-ZD4, 1, USNM 91738; MN-ZCC1, 2, USNM 91732; MN-ZU13, 6, USNM 91729; MN-ZU15, 11, USNM 91730, 1, SAM-H4582; MN-ZW6, 1, USNM 91731. Reference specimens: Gardiner & Waugh's (1938) specimens from: JM-104, 1, BM 1950.1.9.1; JM-106, 3, BM 1950.1.9.11-35; JM-123, 1, BM 1950.1.9.2-3; JM-157, 2, 1950.1.9.36-40.

Remarks

Although I (Cairns 1989a, 1989b) previously distinguished the western Indian Ocean specimens of *Flabellum* from *F. pavoninum*, based on discriminant analysis, additional specimens of typical *F. pavoninum* recently examined from off Japan convince us that these specimens are conspecific. Almost all characters analysed of *F. pavoninum* and *F. pavoninum* sensu Gardiner (1902) in the discriminant analysis (Cairns 1989a, table 5) were overlapping.

Distribution

Indian Ocean: off Durban (Gardiner 1902) to Zululand, South Africa; off Zanzibar and Pemba, Tanzania (Gardiner & Waugh 1938); off Kenya (Cairns 1989b); off western Madagascar (Zibrowius *et al.* 1975); Madagascar Plateau; Mascarene Plateau; Arabian Sea (Gardiner & Waugh 1938); Maldiv Islands (Gardiner & Waugh 1938);

98–665 m. Elsewhere: off Japan; South China Sea; Hawaii; 223–271 m (Cairns 1989b).

Genus *Truncatoflabellum*

KEY TO THE SOUTH-WEST INDIAN OCEAN SPECIES OF *TRUNCATOFLABELLUM*

- 1A. Corallum small (GCD < 13 mm); septa few (some S_3 may be present, but never a full cycle) 2
- 1B. Corallum medium- to large-sized, robust (adult GCD usually over 15 mm); septa more numerous (usually > 80, often with S_6) 4
- 2A. Coralla with only three cycles of septa, often with some S_4 (i.e. 32 septa) *T. pusillum* Cairns, 1989b
- 2B. Coralla with four cycles of septa, often with some S_5 (i.e. 56 septa) 3
- 3A. Thecal edges carinate (not spinose); anthocyathus and anthocaulus invariably separate *T. gardineri* sp. nov.
- 3B. Thecal edges rounded (also usually non-spinose); anthocyathus and anthocaulus often remain attached *T. zuluense* sp. nov.
- 4A. Thecal edges rounded, no thecal spines 5
- 4B. Thecal edges not rounded: either spinose or carinate 6
- 5A. Thecal edge angle large (about 68°); anthocyathus basal scar small (3,5 × 2,5 mm) *T. stabile* (von Marenzeller, 1904)
- 5B. Thecal edge angle less than 60°; anthocyathus scar larger, 5,1–6,7 × 4,0–4,8 mm *T. inconstans* von Marenzeller, 1904
- 6A. Thecal edges of anthocyathus spinose, with up to 7 pairs of spines *T. multispinosum* sp. nov.
- 6B. Thecal edges of anthocyathus acute, often carinate, having no spines *T. formosum* Cairns, 1989b

Truncatoflabellum sp. cf. *T. stabile* (von Marenzeller, 1904)

Fig. 10C, F

New record

V-2629, 1, IOM.

Diagnosis

A unique specimen measures 47,6 × 25,8 mm in calicular diameter and 61,3 mm tall. Angle of thecal edges a constant 68°; inclination of thecal faces 32°. Theca worn, although septa are freshly preserved. Thecal edges rounded; no thecal edge spines or crests present. Basal scar small, only 3,5 × 2,5 mm in diameter. Corallum dense and white, with an evenly arched upper calice. Septa hexamerally arranged according to the formula: $S_1-S_3>S_4>S_5$. Four pairs of S_6 occur in four random half-systems, for a total of 104 septa. Inner septal edges straight; septa concave near junction with calice. Fossa quite deep, containing a rudimentary columella composed of lower, inner edges of S_1-S_4 .

Remarks

This specimen corresponds to the description and illustrations of *Truncatoflabellum stabile* (von Marenzeller, 1904: 273–274, pl. 17 (fig. 12)); however, no comparative specimens have been examined of this species, since the type apparently is missing (Zibrowius 1980). Although similar to the *Truncatoflabellum* reported by Zibrowius & Gili (1990) from Walvis Ridge in shape and in having a small basal scar, it differs in having five cycles of septa, not four. It is most similar to *T. inconstans*, especially in corallum size, number of septa, and in lacking thecal edge spines, but appears to differ in having a higher thecal edge angle (and thus a much more open calice) and a smaller anthocyathus basal scar (see Key).

Distribution

Off south-eastern Mozambique; 1 250–1 520 m. Distribution of *T. stabile*: Cape Verde, Selvagens, and Madeira islands; 1 450–3 010 m (Zibrowius & Gili 1990).

Truncatoflabellum formosum Cairns, 1989b

Fig. 10I, 11A

Truncatoflabellum formosum Cairns, 1989b: 69–70, pl. 35 (figs j–k), pl. 36 (figs a–b) [synonymy].

New records

V–2635, 2, IOM, 1, USNM 91757; MN–ZCC2, 1, USNM 91760.

Remarks

The Indian Ocean specimens were compared to the types of *T. formosum* and found to be indistinguishable. The illustrated specimen measures $20,0 \times 13,6$ mm in calicular diameter and 23,7 mm in height.

Distribution

Indian Ocean: off Zululand, South Africa; off south-eastern Mozambique; 150–230 m. Elsewhere: Korea Strait; Philippines; Celebes; 37–933 m (Cairns 1989b).

Truncatoflabellum pusillum Cairns, 1989b

Fig. 11E

Truncatoflabellum pusillum Cairns, 1989b: 71–72, pl. 37 (figs a–e).

New records

AB–371E, 1, USNM 91755; AB–371F, 35, USNM 91756, 1, SAM–H4587.

Remarks

The specimens from Mozambique agree in all respects with the type specimens of *T. pusillum* from the Philippines, the largest anthocyathus measuring $8,39 \times 6,22$ mm in calicular diameter and 12,2 mm in height.

Distribution

Indian Ocean: off south-eastern Mozambique; 110–132 m. Elsewhere: Philippines; 143–146 m (Cairns 1989b).

Truncatoflabellum gardineri sp. nov.

Fig. 11B-D

Records

Holotype: AB-390S, 1, USNM 91736. Paratypes: AB-390S, 132, USNM 91737, 3, SAM-H4577.

Description

Lower half of anthocyathi compressed, their lateral edges carinate in a series of low, thin, discontinuous ridges projecting outward up to 1,3 mm; upper half of anthocyathi less compressed (GCD : LCD = 1,30-1,47), their edges evenly rounded and essentially parallel. Inclination of convex thecal faces 14-18°. Coralla small and elongate: holotype (an anthocyathus) 10,9 × 8,3 mm in calicular diameter and 17,4 mm in height, with a basal scar diameter of 5,5 × 3,2 mm. Largest anthocyathus 12,7 mm in GCD and 18,7 mm in height. Basal anthocyathus scar elliptical: 4,1-5,3 × 2,8-3,3 mm in diameter. Corallum white. Anthocauli also have carinate edges, a pedicel diameter of 2,1-2,5 mm, four cycles of septa, and rarely exceed 10 mm in height.

Septa hexamerally arranged in four complete cycles ($S_1-S_2 > S_3 > S_4$), only the largest specimens having four pairs of rudimentary S_5 in the end quarter-systems (56 total septa). Inner edges of S_1 and S_2 vertical and highly sinuous, their lower, inner edges fusing deep in fossa to form a rudimentary columella. S_3 half to three-quarters width of S_1 and S_2 and less sinuous; S_4 much smaller than S_3 , with dentate to lacinate inner edges. All septal faces covered with prominent granules. Fossa deep and elongate.

Remarks

T. P. Lowe observed living specimens of this species shortly after capture and observed that each anthocyathus had two tentacular rings, the outer composed of small, white tentacles, the inner composed of larger tentacles with white tips and blood-red bases. Furthermore, he noted six orange stripes on the calice extending from the calicular edge to the outer tentacular ring.

Of the 28 species of *Truncatoflabellum* listed by Cairns (1989a), almost all have one or more pairs of thecal edge spines on their anthocyathi. In the few non-spinose species, the lateral edges are either rounded or sharp-edged. *Truncatoflabellum gardineri* sp. nov. is therefore unique in having non-spinose, carinate thecal edges. It is further distinguished by its relatively small size, parallel thecal edges, and low number of septa. It is similar to *T. pusillum* in corallum and scar size, but can be distinguished by its greater number of septa (48 vs 32) and in having non-spinose, parallel thecal edges.

Etymology

Named in honour of John Stanley Gardiner, who published significant papers on the deep-water corals of the south-west Indian Ocean (see Introduction and Table 1).

Distribution

Known only from the type locality: 29°34'S 31°42'E (off Durban, South Africa), 138 m.

Truncatoflabellum zuluense sp. nov.

Fig. 11F–G

Records

Holotype: MN-ZK21, 1, USNM 91747. Paratypes: MN-ZC9, 2, USNM 91748, 1, SAM-H4581; MN-ZC10, 2, USNM 91749; MN-ZC11, 1, USNM 91750; MN-ZDD2, 1, USNM 91753; MN-ZDD3, 1, USNM 91754; MN-ZK20, 2, USNM 91751; MN-ZK21, 2, USNM 91752.

Description

In all 13 specimens examined, the anthocyathi and anthocauli remained together as one corallum, but a difference in corallum colour and an incipient fracture line usually indicated where the separation would occur. Corallum compressed (GCD : LCD = 1,4–1,65–1,8), with rounded thecal edges diverging at a constant angle of 28–38°. Inclination of thecal faces 18–22°. Coralla small: holotype 13,2 × 7,9 mm in calicular diameter and 17,2 mm in height, with a pedicel diameter of 1,9 mm. Lower 6 mm of corallum (presumed anthocaulus) white and usually non-spinose but sometimes bearing one pair of short thecal edge spines. At corallum height of about 6 mm and a calicular diameter of about 6,0–6,5 × 4,5 mm, the corallum bears a transverse crease, which is presumed to be the incipient fracture line, above which the corallum (anthocyathus) is reddish-brown. Anthocyathi also usually non-spinose but occasionally bear one pair of short thecal edge spines basally.

Septa hexamerally arranged in four cycles ($S_1-S_2>S_3>>S_4$), larger specimens also having pairs of S_5 in the end half-systems (total of 56 septa). Inner edges of S_1 and S_2 vertical and sinuous, defining a deep and narrow fossa. S_3 about two-thirds width of larger septa; S_4 much smaller, usually with finely dentate inner edges. All septa covered with tall granules.

Remarks

Truncatoflabellum zuluense sp. nov. is distinguished from most other species in the genus by its small size and by having only 48–56 septa; rarely having thecal spines; and in maintaining the anthocaulus–anthocyathus connection long into ontogeny. *Truncatoflabellum zuluense* is most similar to *T. gardineri* sp. nov., another relatively shallow-water, south-west Indian Ocean species, especially in corallum size and septal number, but can be distinguished by its rounded, sometimes spinose, divergent thecal edges (not carinate and parallel); retention of the anthocaulus stage; and reddish-brown corallum colour.

Etymology

The species name *zuluense* is an allusion to the area of capture of the type series: off Zululand, South Africa.

Distribution

Known only from off Zululand, South Africa; 62–84 m. Type locality: 27°47,6'S 32°39,1'E, 62–84 m.

Truncatoflabellum multispinosum sp. nov.

Figs 11H, 12A–C

Records

Holotype: V-2634, 1, USNM 91739. Paratypes: AB-372L, 55, USNM 91741, 1, SAM-H4580; AB-409E, 2, USNM 91742; MN-ZB11, 1, USNM 91743; MN-ZB17, 1, USNM 91744; MN-ZDD4, 1, USNM 91746; MN-ZH18, 2, USNM 91745; CH11-329-10, 2, USNM 91740.

Description

Angle of acute thecal edges 41–56°; inclination of convex thecal faces 19–32°. Largest anthocyathus (holotype) 32,2 × 15,7 mm in calicular diameter and 28,1 mm in height, with a basal scar diameter of 7,3 × 4,8 mm. Up to seven pairs of slender spines project from thecal edges, usually regularly occurring from scar to calice, the number determined by size of corallum. Basal scar of anthocyathus elliptical: 5,6–7,3 × 4,2–4,8 mm in diameter. Calice elliptical, GCD : LCD = 1,67–1,83–2,05. Theca of anthocyathus reddish-brown, often more intensely striped vertically; septa of anthocyathus and entire anthocaulus white. Anthocauli rarely greater than 7,5 mm in height, having the calicular diameter of the anthocyathus basal scar. Anthocauli have a pedicel diameter of 1,8–2,0 mm, 24 septa, and one pair of thecal edge spines.

Septa of large coralla (e.g. over 23 mm GCD) hexamerally arranged in five cycles according to the formula: $S_1-S_3>S_4>S_5$, often with four pairs of S_6 in the four quarter-systems adjacent to the two principal S_1 ; however, the large holotype lacks two pairs of S_5 in lateral half-systems, resulting in 100 septa. In medium-sized anthocyathi (e.g. GCD = 10–22 mm), symmetry appears to be decamerall, coralla often having the formula: 20 : 20 : 40 (80 septa), with irregular development of tertiary septa in lateral half-systems and accelerated development in the end half-systems. S_1-S_3 have finely sinuous, vertical inner edges, which define a narrow, elongate fossa. S_4 only slightly smaller, their inner edges sometimes also reaching the columella. S_5 about one-third width of S_4 ; S_6 rudimentary. Columella a trabecular fusion of lower, inner edges of S_1-S_3 and occasionally the S_4 .

Remarks

Among the 30 described species of *Truncatoflabellum* (see Cairns 1989b), *T. multispinosum* sp. nov. most closely resembles *T. candeanum* (Milne Edwards & Haime, 1848), particularly in thecal colour, number of septa, and in having relatively widely divergent thecal edges. *Truncatoflabellum multispinosum* sp. nov. differs consistently, however, in having a smooth calicular edge (that of *T. candeanum* is scalloped); larger S_4 in relation to the S_1-S_3 ; a larger anthocyathus scar; and slightly less divergent thecal edges and faces. *Truncatoflabellum vanuatu* (Wells, 1984) is the only species known to have up to five pairs of thecal spines, but differs in having a much smaller anthocyathus

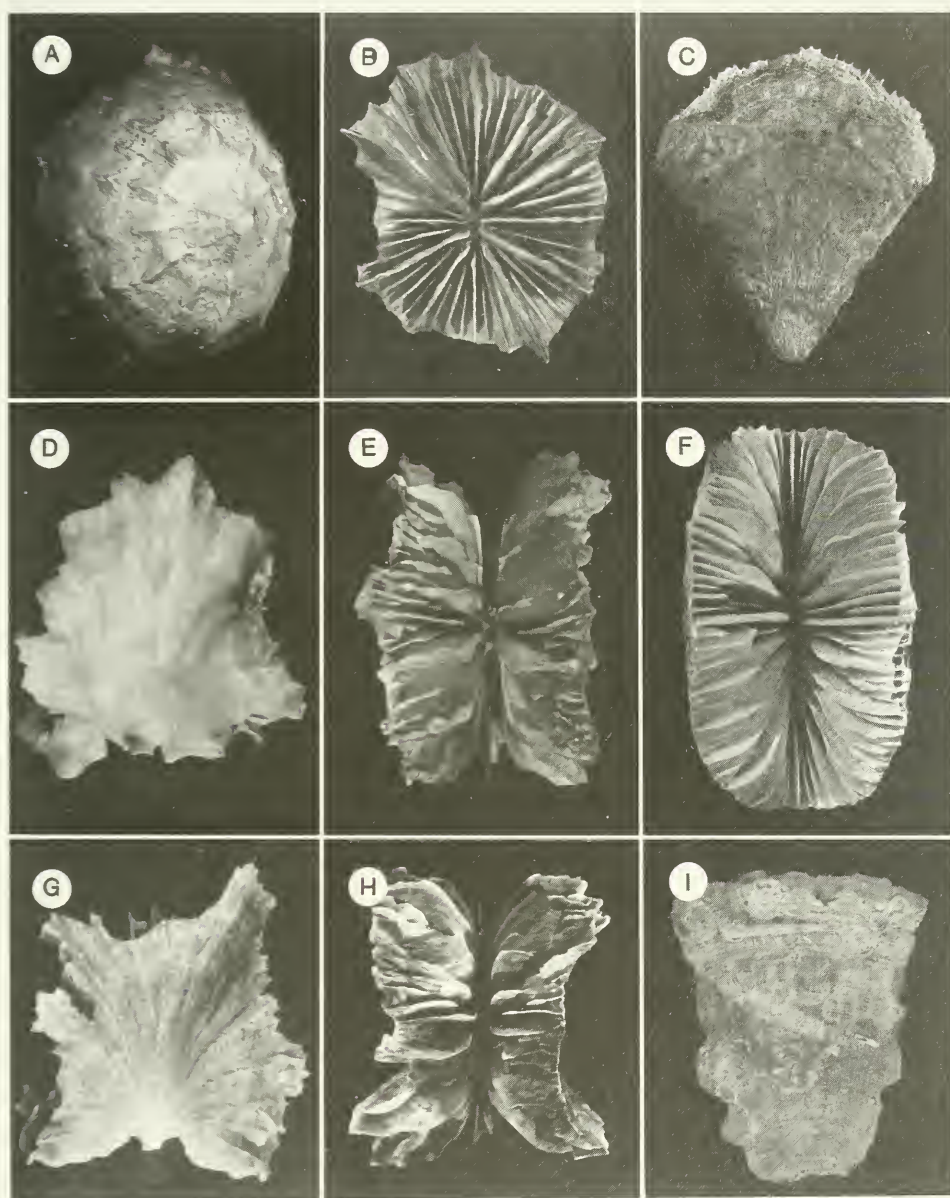


Fig. 10. A-B. *Flabellum japonicum bythios* subsp. nov., V-2815, IOM, basal and calicular views. Both $\times 1.0$. C, F. *Truncatoflabellum* sp. cf. *T. stabile*, V-2629, IOM, lateral and calicular views. C $\times 0.8$, F $\times 1.1$. D-E. *Flabellum lowekeyesi*, V-2668, USNM 91734, lateral and calicular views. D $\times 1.2$, E $\times 1.7$. G-H. *Flabellum messum*, V-2816, USNM 91735, lateral and calicular views. G $\times 1.0$, H $\times 1.3$. I. *Truncatoflabellum formosum*, V-2635, USNM 91757, lateral view. $\times 1.8$.

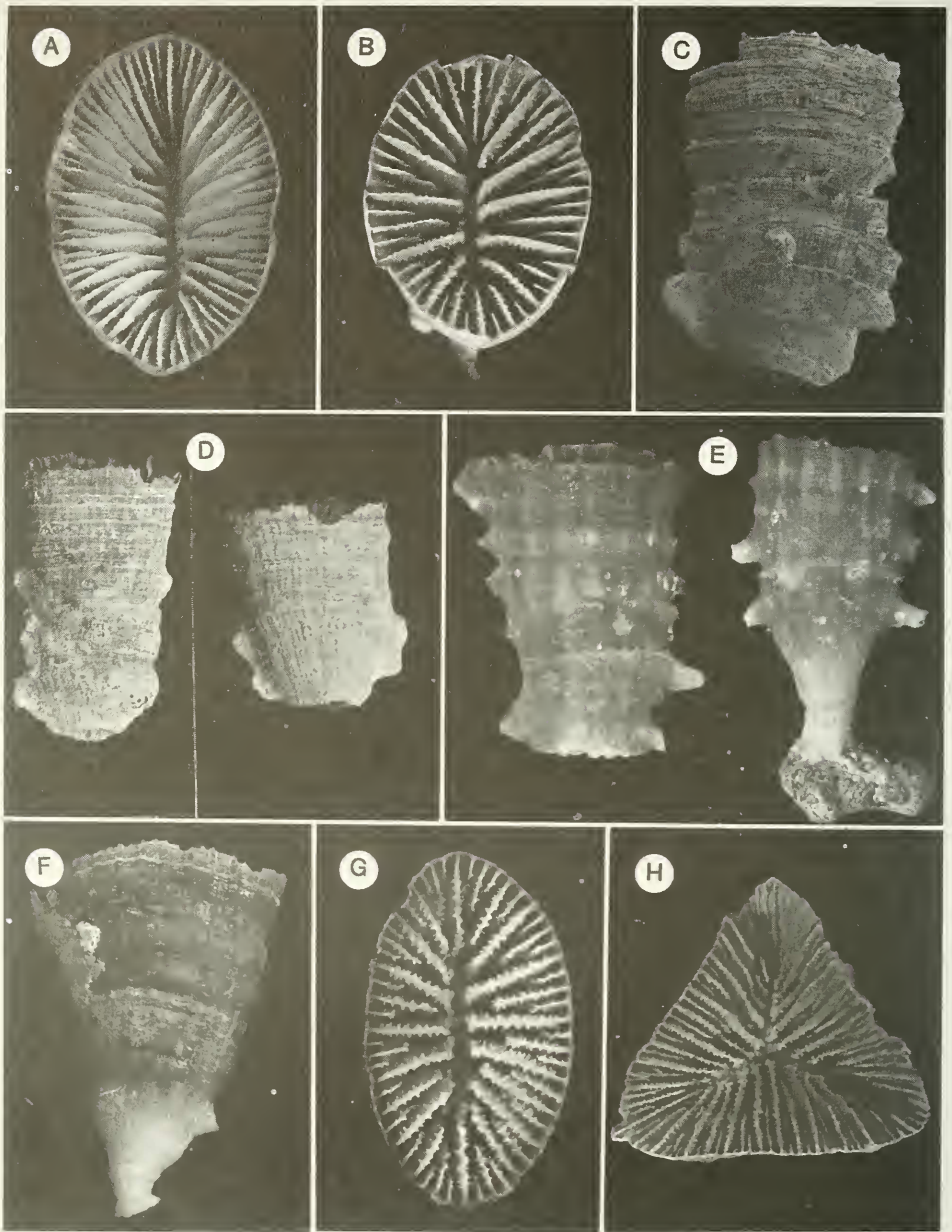


Fig. 11. A. *Truncatoflabellum formosum*, V-2635, USNM 91757, calicular view. $\times 2.4$. B-D. *Truncatoflabellum gardineri* sp. nov. from AB-390S. B-C. Calicular and lateral views of holotype. B $\times 3.9$, C $\times 2.9$. D. Lateral view of two paratypes. $\times 2.2$. E. *Truncatoflabellum pusillum*, AB-371F, USNM 91756, lateral view of anthocyathus and anthocaulus. $\times 5.2$. F-G. *Truncatoflabellum zuluense* sp. nov., MN-ZK21 (holotype), lateral and calicular views. F $\times 2.9$, G $\times 3.8$. H. *Truncatoflabellum multispinosum* sp. nov., aberrant paratype from AB-372L. $\times 2.2$.

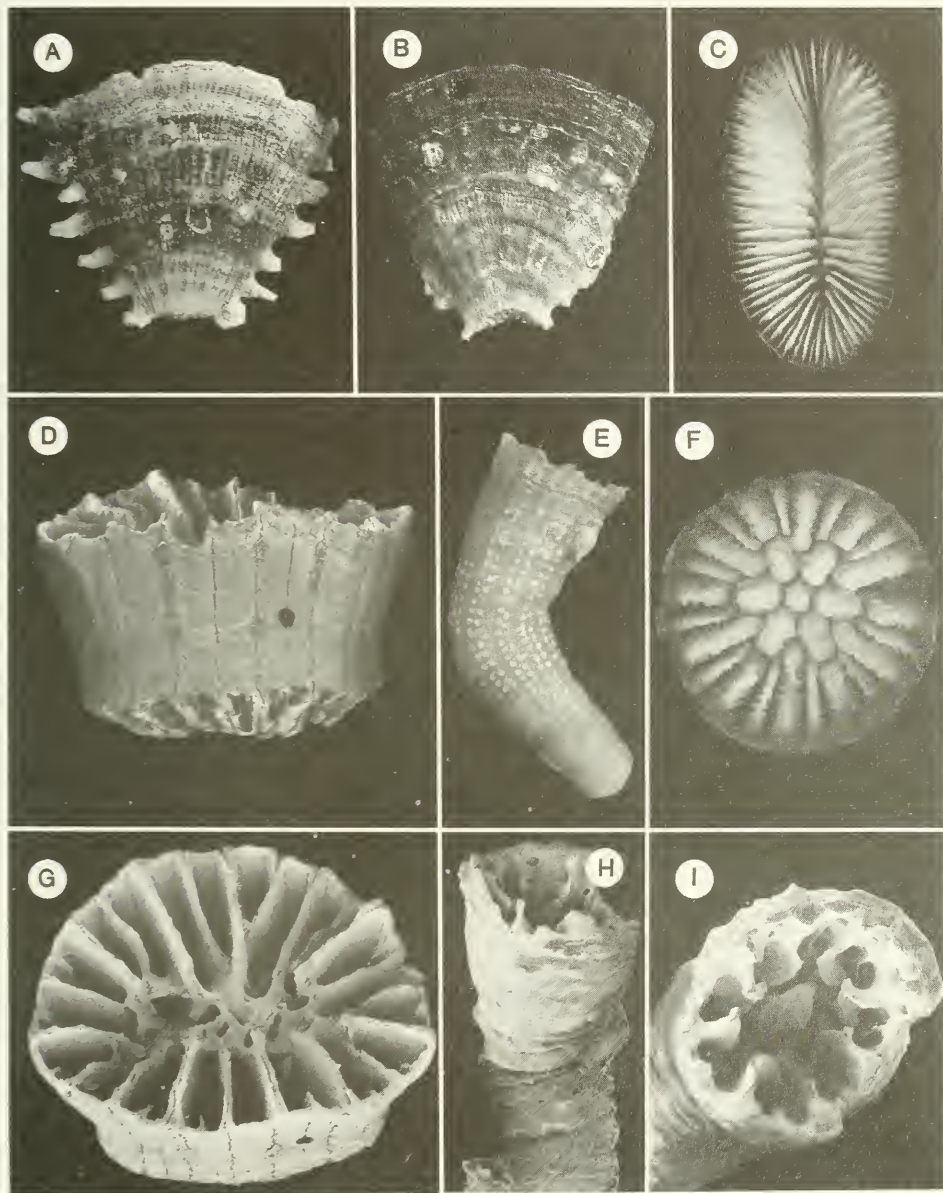


Fig. 12. A-C. *Truncatoflabellum multispinosum* sp. nov. A. Lateral view of paratype from AB-372L (USNM 91741) showing seven pairs of lateral spines. $\times 1.7$. B-C. V-2634, lateral and calicular views of holotype. B $\times 1.2$, C $\times 1.5$. D, G. *Placotrochides scaphula*, AB-389C, USNM 91772, lateral and calicular views. D $\times 8.1$, G $\times 8.4$. E-F. *Stenocyathus vermiformis*, V-2722, USNM 91775, lateral and calicular views. E $\times 3.7$, F $\times 7.4$. H-I. *Guynia annulata*, AB-390S, USNM 77201, lateral and calicular views. H $\times 17$, I $\times 23$.

scar; having a much narrower anthocyathus (edge angle only 20–27°); and in having fewer septa.

Etymology

The species name *multispinosum* (from the Latin *multus*, more + *spina*, spine) is an allusion to the numerous thecal edge spines characteristic of this species.

Distribution

Off Zululand, South Africa; off south-eastern Mozambique; Mozambique Channel off western Madagascar; off Zanzibar, Tanzania; 62–183 m. Type locality: 25°05'S 34°50'E (south-eastern Mozambique), 90–92 m.

Genus *Javania*

Javania insignis Duncan, 1876

Javania insignis Duncan, 1876: 435, pl. 39 (figs 11–13). Von Marenzeller, 1907b: 23, pl. 2 (fig. 6). Zibrowius, 1974b: 8–9, pl. 1 (figs 1–6). Fricke & Schuhmacher, 1983: 184. Scheer & Pillai, 1983: 165–166, text-fig. 4, pl. 37 (figs 9–12). Cairns, 1989b: 77–78, pl. 40 (figs d–e, h, j, k) [synonymy]. *Flabellum weberi* Alcock, 1902a: 107. Cairns, 1989b: 77. [syn. nov.]

New records

AB–371F, 1, SAM–H4591; MN–ZC11, 1, USNM 91768; MN–ZDD3, 2, USNM 91770; MN–ZQ8a, 1, USNM 91769. Reference specimen: holotype of *Flabellum weberi*, Siboga–310, ZMA 1232.

Distribution

Indian Ocean: off Natal and Zululand, South Africa; off south-eastern Mozambique (Cairns, 1989b); off north-western Madagascar (Zibrowius 1974b); Red Sea (Von Marenzeller 1907b; Fricke & Schuhmacher 1983; Scheer & Pillai 1983); 74–255 m. Elsewhere: off Japan; Philippines; Indonesia; Hawaiian Islands; 46–825 m (Cairns 1989b).

Genus *Placotrochides*

Placotrochides scaphula Alcock, 1902b

Fig. 12D, G

Placotrochides scaphula Alcock, 1902b: 121–122; 1902c: 34, pl. 4 (fig. 32, 32a). Cairns, 1989b: 78–79, pl. 40 (fig. 1), pl. 41 (figs a–e) [synonymy].

New records

AB–365D, 1, USNM 91771; AB–389C, 4, USNM 91772; AB–389E, 1, USNM 91773.

Remarks

The south-west Indian Ocean specimens are similar to the holotype of *P. scaphula* from Indonesia, more so than those specimens reported by Cairns (1989b) from

the Philippines, which are considerably larger and have more septa. The figured specimen measures 6.43×4.97 mm in calicular diameter and has 18 major septa.

Distribution

Indian Ocean: off Natal, South Africa; off south-western Madagascar; 475–1 360 m. Elsewhere: Philippines; Indonesia; 462–1 628 m (Cairns 1989b).

Family Guyniidae

Genus *Guynia*

Guynia annulata Duncan, 1872

Fig. 12H–I

Guynia annulata Duncan, 1872: 32, pl. 1 (figs 1–8). Cairns, 1984: 23, pl. 5 (figs A–B); 1989b: 42, pl. 21 (fig. f), pl. 22 (figs a–e) [synonymy]. Cairns & Parker, 1992: 42–43, pl. 14 (figs g–h). *Pyrophyllia inflata* Hickson, 1910: 1–7, text-figs 1–4; 1911: 1 038–1 042. Harrison, 1911: 1 020, pl. 57 (figs 8–11), pl. 58 (figs 18–19).

New records

AB–372L, 3, USNM 77202; AB–390S, 2, USNM 77201.

Distribution

Indian Ocean: off Durban, South Africa; off south-eastern Mozambique; Gulf of Oman (Hickson 1910, 1911; Harrison 1911); 112–286 m. Elsewhere: probably cosmopolitan—amphi-Atlantic; Indonesia; Philippines; New Caledonia; Hawaiian Islands; southern Australia; 28–653 m (Cairns & Parker 1992).

Genus *Stenocyathus*

Stenocyathus vermiformis (Pourtalès, 1868)

Fig. 12E–F

Coenocyathus vermiformis Pourtalès, 1868: 133.

Stenocyathus vermiformis: von Marenzeller, 1904: 298–300, pl. 18 (fig. 16). Zibrowius, 1974a: 769–770. Cairns, 1979: 168–170, pl. 32 (figs 8–10), pl. 33 (figs 1–2) [synonymy]; 1982: 52, pl. 16 (figs 8–11); 1984: 23–25, pl. 5 (fig. c). Cairns & Parker, 1992: 43–44, pl. 14 (figs b–c).

New records

V–2722, 1, USNM 91775; V–2723, 1, IOM.

Distribution

Indian Ocean: Madagascar Plateau near Walters Shoal; St Paul and Amsterdam Islands (Von Marenzeller 1904; Zibrowius 1974a); 80–672 m. Elsewhere: amphi-Atlantic, off New Zealand; Tasmania; Great Barrier Reef; 80–1 229 m (Cairns & Parker 1992).

Suborder DENDROPHYLLIINA

Family **Dendrophylliidae**Genus *Balanophyllia**Balanophyllia stimpsonii* (Verrill, 1865)

Eupsammia stimpsonii Verrill, 1865: 150.

Rhodopsammia socialis: Alcock, 1893: 147.

Balanophyllia socialis: Bourne, 1905: 210, pl. 2 (fig. 8, 8a). Harrison & Poole, 1909: 902.

Balanophyllia imperialis: van der Horst, 1926: 48.

Balanophyllia affinis: van der Horst, 1931: 10. Gardiner & Waugh, 1939: 240.

Balanophyllia cumingii: Gardiner & Waugh, 1939: 238, pl. 1 (fig. 1).

Balanophyllia stimpsonii: Zibrowius, 1985: 234–235 [synonymy]. Zibrowius & Grygier, 1985: 126–127, figs 27–29.

New records

V-2634, 1, IOM; AB-372L, 2, USNM 77228.

Distribution

A common, free-living, shallow-water Indo-West Pacific species. Indian Ocean: False Bay and off Natal, South Africa (Zibrowius 1985); off Mozambique; off Somalia (Zibrowius & Grygier 1985); Seychelles and Reunion (Zibrowius 1985); Gulf of Oman (Zibrowius & Grygier 1985); off Sri Lanka (Van der Horst 1926; Gardiner & Waugh 1939); Gulf of Manaar (Bourne 1905); Maldives Islands (Gardiner & Waugh 1939); Andaman Sea (Alcock 1893); Mergui Archipelago (Harrison & Poole 1909); 11–112 m. Elsewhere: Philippines; Indonesia; Chesterfield Islands; eastern Australia (Zibrowius 1985).

Balanophyllia ponderosa van der Horst, 1926

?*Eupsammia regalis* Alcock, 1893: 144–145, pl. 5 (fig. 8, 8a).

Balanophyllia ponderosa van der Horst, 1926: 49–50, pl. 3 (figs 6–7). Eguchi, 1968: C54 [part.—pl. C17 (figs 6–11, 13–14)]. ?Boshoff, 1981: 41.

New record

MN-ZA48, 1, USNM 91777. Reference specimen: holotype of *B. ponderosa* (BM 1939.7.20.62).

Remarks

This specimen, measuring 20,4 × 15,8 mm in calicular diameter and 26,7 mm in height, is identical to the holotype of *B. ponderosa* van der Horst (1926), except that the specimen lacks epitheca and is unattached, perhaps both the result of damage early in ontogeny. In this regard, however, it is very similar to the original illustration of *B. regalis* (Alcock, 1893), which may prove to be the senior synonym if the type of *B. regalis* can be obtained.

Distribution

Indian Ocean: ?off Durban (Boshoff 1981); off Zululand, South Africa; Seychelles (Van der Horst 1926); Maldives Islands (Van der Horst 1926); ?off Sri Lanka (Alcock 1893); 51–59 m. Elsewhere: off Japan; 10–250 m (Eguchi 1968).

Balanophyllia diffusa Harrison & Poole, 1909

Fig. 13A, D

Balanophyllia diffusa Harrison & Poole, 1909: 906, pl. 85 (fig. 4a, b). Gardiner & Waugh, 1939: 239–240. ?Pillai & Scheer, 1976: 16.

Non *Balanophyllia diffusa* Harrison & Poole. Scheer & Pillai, 1983: 168.

New records

AB–372L, 2, USNM 91781; AB–390S, 1, USNM 91782; EAMFRO–C13, 2, USNM 78637; Cr. 329, Sta. 15, 2, USNM 78594 and 78639; MN–ZC10, 1, USNM 91780. Reference specimens: *B. diffusa* of Gardiner & Waugh (1939): JM–112, 4, BM 1939.7.13.67; JM–157, 10, BM 1950.1.6.35.

Remarks

Eight specimens appear to be conspecific with *B. diffusa*, based on the original description and figures of this species. The quasi-colonial nature of the *B. diffusa* reported by Gardiner & Waugh (1939) from Tanzania, Red Sea, and Maldivé Islands, is simply due to specimens settling close to one another.

Distribution

Off Durban and Zululand, South Africa; off south-eastern Mozambique; off Pemba (Gardiner & Waugh 1939) and Zanzibar, Tanzania; north Kenya Banks; Mergui Archipelago (Harrison & Poole 1909); Maldivé Islands (Gardiner & Waugh 1939; Pillai & Scheer 1976); 6–274 m.

Genus *Trochopsammia*

Trochopsammia togata (van der Horst, 1927) comb. nov.

Balanophyllia togata van der Horst, 1927: 5–6, pl. 2 (figs 10–11), text-fig. 3.

Thecopsammia togata: Wells, 1935: 531.

New records

AB–358A, 1, USNM 77237; MN–SM226, 1, USNM 91792, 1, SAM–H4592; MN–SM232, 4, USNM 91791.

Remarks

Trochopsammia togata cannot be placed in the genus *Balanophyllia*, because its septa are not arranged in a Pourtalès Plan. For the same reason, it cannot be placed in *Thecopsammia*, even though Vaughan & Wells (1943) and Wells (1956) incorrectly assumed that *Thecopsammia socialis* (type species of that genus) has normally arranged septa (see Cairns 1979). *Trochopsammia togata* is more similar to *Trochopsammia*, which is known from only the type species, *T. infundibulum* Pourtalès, 1878, differing primarily in not having well-defined costae. *Trochopsammia togata* can be diagnosed as having a slender, epithecate elongate corallum; fewer than four cycles of normally arranged septa, the four lateral S_1 being wider than the other two; and lacking a columella.

Distribution

Agulhas Bank (Wells 1935) to Durban, South Africa (Van der Horst 1927); 155–775 m.

Genus *Endopachys**Endopachys grayi* Milne Edwards & Haime, 1848b

Endopachys grayi Milne Edwards & Haime, 1848b: 82–83, pl. 1 (fig. 2). Van der Horst, 1926: 51; 1927: 6–7, pl. 2 (fig. 12). Gardiner & Waugh, 1939: 241. Boshoff, 1981: 42 [*part.*]. Cairns, 1984: 27, pl. 5 (fig. E) [synonymy]. Zibrowius & Grygier, 1985: 128, figs 39–42. Cairns, 1989b: 34. *Endopachys weberi* Alcock, 1902a: 109–110 [syn. nov.].

New records

V–2634, 12, IOM; V–2809, 6, IOM, 1, USNM 91811; AB–371F, 1, USNM 77247; AB–372J, 3, USNM 77251; AB–372L, 82, USNM 77245; AB–390S, 15, USNM 77248, 2, SAM–H4593, 2, NM; AB–391H, 1, USNM 77252; AB–391J, 3, USNM 77246; *Vema* 14–SAT6, 5, USNM 77254; MN–ZDD2, 1, USNM 91813; MN–ZW8, 3, USNM 91812.

Remarks

The specimen from V–2809, measuring $38,9 \times 32,7$ mm in calicular diameter and 34,0 mm in height, is believed to be the largest recorded, yet only slightly larger than the holotype. It nonetheless has only five cycles of septa (96).

Distribution

Indian Ocean: off South Africa from off Bisho (Van der Horst 1927) to Zululand (Van der Horst 1927; Zibrowius & Grygier 1985); off south-eastern Mozambique; off Zanzibar, Tanzania (Cairns 1989b); off Mauritius (Van der Horst 1926) and Saya de Malha; north-eastern Arabian Sea (Gardiner & Waugh 1939); 57–274 m. Elsewhere: Western Pacific; Hawaiian Islands; Gulf of California; 37–274 m (Cairns 1984).

Genus *Rhizopsammia**Rhizopsammia annae* (van der Horst, 1933)

Fig. 13C

Balanophyllia annae van der Horst, 1933: 156–158, pl. 7 (figs 14); 1938, pl. 5 (fig. 1). Boshoff, 1981: 40.

Rhizopsammia annae: Zibrowius & Gili, 1990: 44.

New record

AB–391J, 1 colony, USNM 91790.

Distribution

Known only from off South Africa from the Cape of Good Hope (Van der Horst 1933) to Port Shepstone (Boshoff 1981); 0–80 m.

Rhizopsammia compacta Sheppard & Sheppard, 1991

Fig. 13B, E

Rhizopsammia compacta Sheppard & Sheppard, 1991: 153, fig. 179.*New records*

AB-357B, 2, USNM 91794; AB-371F, 6, USNM 91795; MN-ZA43, 1, USNM 91796; MN-ZA48, 3, USNM 91797, 1, SAM-H4578; MN-ZA49, colony of 9 corallites, USNM 91793; MN-ZB11, 1, USNM 91798; MN-ZB14, 1, USNM 91799; MN-ZB17, 1, USNM 91800; MN-ZB18, 1, USNM 91801; MN-ZB20, 2, USNM 91802; MN-ZB23, 1, USNM 91803; MN-ZB25, 1, USNM 91804; MN-ZD5, 1, USNM 91805; MN-ZD7, 4, USNM 91806; MN-ZD10, 2, USNM 91807; MN-ZDD2, 2, USNM 91808; MN-ZDD3, 3, USNM 91809, 2, SAM-H4579; MN-ZDD5, 1, USNM 91810.

Redescription

Colonies irregularly shaped, composed of clumps of corallites interconnected by narrow stolons or consisting of small corallites budded from lower edge zone of larger corallites. Individual corallites broken from the substrate are indistinguishable from *Balanophyllia*. Corallites cylindrical to ceratoid in shape, the calice usually circular in young corallites but often becoming highly compressed in larger corallites, with a GCD : LCD up to 3.0. Largest colony examined (MN-ZA49) composed of 9 corallites, the largest 21.1×7.3 mm in calicular diameter and 27.2 mm in height, with slightly concave thecal faces. Costae equal in width, covered with fine spines; no epitheca. Corallum white, but often encrusted basally with red foraminifera.

Septa hexamerally arranged in five cycles (96 septa), only the largest corallites having pairs of S_6 , e.g. the large corallite from MN-ZA49 has 8 pairs of S_6 in three of its half-systems for a total of 112 septa. S_1 – S_3 equal in size, only slightly exsert, and have vertical inner edges descending into a deep fossa. S_4 – S_6 slightly less exsert than S_1 – S_3 , the S_4 being the narrowest of the septa, flanked by pairs of S_5 , which are slightly less wide than S_1 – S_3 in the upper fossa, but equal in width to S_1 – S_3 in lower fossa, where each pair of S_5 joins before its enclosed S_4 . Septa closely spaced, giving a crowded aspect; septal faces covered by tall, robust granules. All inner septal edges straight: entire in upper fossa, finely dentate in lower fossa. Paliform lobes absent.

Fossa contains an elongate, spongy, flat columella that fuses to lower, inner edges of S_1 – S_3 , and S_5 .

Remarks

This recently described species is redescribed herein, the original account being based on only one specimen. The equally wide, vertically-edged S_1 – S_3 and S_5 of *R. compacta* produce a well-delineated fossa, which is characteristic of the species and helps to distinguish it from all others. Furthermore, it differs from the 11 other valid species in the genus (see Wells (1982) for listing of 8 species; plus *R. annae* (van der Horst, 1933); *R. wettsteini* Scheer & Pillai, 1983; and *R. eguchi* (Wells, 1982)) by having relatively large corallites with compressed calices; five full cycles of septa; S_1 – S_3 equal in size; and no pali. It is perhaps most similar to *R. manuelensis* Chevalier, 1966, particularly in corallum shape and corallite size, but *R. manuelensis* differs

in having paliform lobes; exsert septa; one less cycle of septa; and a discrete columella. *Rhizopsammia compacta* differs from *R. wettsteini*, known from the Red Sea, in having larger, compressed corallites and in having equally-sized S_1 – S_3 .

Distribution

Known only from the Indian Ocean off Durban to south-eastern Mozambique (43–110 m) and the Gulf of Oman (35 m). Type locality: off Musandam, Gulf of Oman, 35 m.

Genus *Dendrophyllia*

Dendrophyllia sp. cf. *D. horsti* Gardiner & Waugh, 1939

Fig. 13F, I

?*Dendrophyllia arbuscula* van der Horst, 1922: 53, pl. 8 (fig. 6).

?*Dendrophyllia horsti* Gardiner & Waugh, 1939: 237–238, pl. 2 (figs 5–6). Pillai & Scheer, 1976: 16.

Fricke & Schuhmacher, 1983: 184, fig. 14d. Scheer & Pillai, 1983: 171–172, pl. 39 (figs 11–12).

Dendrophyllia coccinea: van der Horst, 1926: 45–46, pl. 3 (figs 1–3). Gardiner & Waugh, 1939: 236.

New records

AB–372G, 1 colony, USNM 91814; MN–XX153, 1 colony, USNM 91815; MN–ZB11, 3 colonies, USNM 91816; MN–ZB18, 1 colony, USNM 91817; MN–ZB20, 2 colonies, USNM 91818; MN–ZC11, 1 colony, USNM 91819; MN–ZD6, 1 colony, USNM 91820. Reference specimens of Gardiner & Waugh's (1939) *D. coccinea*: JM–112, 1 colony, BM 1939.7.13.83.

Remarks

The south-west Indian Ocean specimens may be characterized as small irregular colonies, usually less than 5 cm in height, composed of 2–5 thick (about 12 mm in diameter), cylindrical corallites budded at angles of 45–80° from the parent corallite. Septa arranged in four cycles ($S_1 > S_2 > S_4 > S_3$), with occasional S_5 ; fossa deep; columella discrete, convex. Because the types of *D. horsti* were not examined, the identification of these specimens must remain tentative. *Dendrophyllia arbuscula* may well be a larger colony of the same species.

Distribution

Off South Africa from Natal to Zululand; off Pemba, Tanzania (Gardiner & Waugh 1939); 50–113 m. Distribution of *D. horsti*: Red Sea (Fricke & Schuhmacher 1983; Scheer & Pillai 1983); Maldiv Islands (Gardiner & Waugh 1939; Pillai & Scheer 1976); ?Indonesia (Van der Horst 1922); 45–229 m.

Dendrophyllia dilatata van der Horst, 1927

Dendrophyllia dilatata van der Horst, 1927: 2–3, pl. 1 (figs 2–4), text-fig. 1. Zibrowius & Gili, 1990: 44.

New records

AB–371E, 4 colonies, USNM 71865; AB–371F, 8 colonies, USNM 71866, 1 colony, SAM–H4571.

Remarks

Dendrophyllia dilatata is similar to the previous species in corallum size, septal arrangement, and geographic distribution, but can be distinguished by having a slightly larger (up to 7 cm), usually arborescent colony composed of up to a dozen sympodially arranged corallites; only four cycles of septa; smaller, ceratoid corallites; and a shallower fossa.

Distribution

Off Durban, South Africa (Van der Horst 1927) to off south-eastern Mozambique; 97–132 m.

Dendrophyllia cladonia van der Horst, 1927

Dendrophyllia cladonia van der Horst, 1927: 3–4, pl. 1 (figs 5–6), pl. 2 (fig. 7), text-fig. 2. Zibrowius & Gili, 1990: 44.

New records

AB–357B, 2 corallites, USNM 91826; AB–357E, 7 corallites, USNM 91825; AB–371F, 3 corallites, USNM 91824; AB–390S, 48 colonies or isolated corallites, USNM 91823.

Remarks

Dendrophyllia cladonia is very similar to *Dendrophyllia* sp. cf. *D. horsti* diagnosed above, especially in colony shape, size, and budding, number of septa, and in having cylindrical corallites. *Dendrophyllia cladonia* differs in having smaller corallites (about 8 mm in GCD), endothecal dissepiments, and in having a highly developed Pourtales Plan, in which the two S_4 in every system that are adjacent to the S_1 are quite large and unite before the S_2 , merging with the columella as one lamella. The S_1 of this species do not quite reach the columella. In *Dendrophyllia* sp. cf. *D. horsti*, S_4 do not join one another and the S_1 are the widest septa.

Distribution

Known only from Port Shepstone, South Africa (Van der Horst 1927) to off south-eastern Mozambique; 49–457 m.

Dendrophyllia gaditana (Duncan, 1873)

Balanophyllia gaditana Duncan, 1873: 333.

?*Dendrophyllia minuscula*: Bourne, 1905: 213, pl. 2 (fig. 11, 11A).

Dendrophyllia praecipua Gardiner & Waugh, 1939: 240, pl. 1 (fig. 2).

?*Dendrophyllia* cf. *gaditana*: Best *et al.*, 1980: 621.

Non *Dendrophyllia minuscula*: Gardiner & Waugh, 1939: 237 (= *Enallopsammia rostrata*).

Non *Dendrophyllia minuscula*: Boshoff, 1981: 42 (= *Dendrophyllia ijimai*).

Non *Dendrophyllia* cf. *minuscula*: Fricke & Schuhmacher, 1983: 184, fig. 14a.

Dendrophyllia gaditana: Cairns, 1979: 181–182, pl. 36 (figs 5–10); 1984: 25, pl. 4 (fig. I) [synonymy].

New records

AB–371F, 1 branch, USNM 91821; AB–401B, 3 colonies, USNM 91822; V–2697, 1 colony, IOM; V–2753, 1 colony, IOM.

Distribution

Indian Ocean: off south-eastern and central Mozambique; off Pemba, Tanzania (Gardiner & Waugh 1939); ?Seychelles (Best *et al.* 1980); Madagascar Plateau near Walters Shoal; ?Gulf of Manaar (Bourne 1905); 65–480 m. Elsewhere: amphiatlantic, Java Sea, off Queensland, Hawaiian Islands (Cairns 1984), off Japan (Cairns in prep.); 73–505 m.

Dendrophyllia ijimai Yabe & Eguchi, 1934

Fig. 13G

Dendrophyllia ijimai Yabe & Eguchi, 1934: 2026. Eguchi, 1968: C65–C66, pl. C16 (figs 1–2), pl. C22 (fig. 1), pl. C30 (figs 4–5).

Dendrophyllia cf. minuscula: Scheer & Pillai, 1983: 170–171, pl. 39 (figs 5–10).

Dendrophyllia minuscula: Boshoff, 1981: 42.

New records

AB-394B, 1 colony, USNM 91844; Cruise 333, sta. 14, 1 colony, USNM 78543; off Zanzibar, 84 m, 1 colony, USNM 78544; MN-ZK21, 1 colony, USNM 91843. Reference material: 2 colonies from off Moroisa, Sagami Bay, USNM.

Diagnosis

Coralla large and arborescent, up to 23 cm wide and 20 cm in height, with a massive base up to 4 cm in diameter. Branches relatively straight and circular in cross-section, each gradually attenuating to a distal axial corallite 5–6 mm in diameter. Non-axial corallites circular to slightly elliptical and smaller (4.5–5.5 mm in diameter) than axials, arranged in three or four irregular rows along branch, each corallite projecting 2–8 mm perpendicular to branch or slightly tilted anteriorly. Theca striate, with well-delineated costae. Corallum white; dried tissue dark brown. Septa hexamerally arranged in four cycles; however, fourth cycle rarely complete in non-axial corallites, whereas some S_5 do occur in axials. S_1 independent and by far the largest septa. S_2 also independent but much smaller. S_3 smallest of septa, each enclosed by a larger pair of S_4 . Columella large and spongy.

Remarks

These specimens appear to be identical to those reported as *Dendrophyllia cf. D. minuscula* by Scheer & Pillai (1983) from the Red Sea. *Dendrophyllia minuscula* Bourne, 1905, has much smaller corallites. Among the approximately 30 valid Recent species of *Dendrophyllia*, these south-west Indian Ocean specimens are indistinguishable from *D. ijimai*, previously known only from off Japan at 37–366 m. Superficially, this species resembles *Tubastraea micrantha* in colour and size, but differ in having septa arranged in the Pourtalès Plan.

Distribution

Off Durban (Boshoff 1981) and Zululand, South Africa; off Zanzibar, Tanzania; off Kenya; Red Sea (Scheer & Pillai 1983); 62–223 m. Elsewhere: off Japan, 37–366 m (Eguchi 1968).

Dendrophyllia fistula (Alcock, 1902a)

Balanophyllia (*Thecopsammia*) *fistula* Alcock, 1902a: 109; 1902c: 42, pl. 5 (fig. 36, 36a).

Thecopsammia fistula: von Marenzeller, 1907a: 8–9, text-fig. 6; 1907b: 16–17, pl. 1 (figs a–h).

Dendrophyllia fistula: Gardiner & Waugh, 1939: 237. Pillai & Scheer, 1976: 16. Scheer & Pillai, 1983: 170 [synonymy].

Non *Dendrophyllia fistula*: Wells, 1954: 472–473, pl. 180 (figs 1–3).

Non *Dendrophyllia fistula*: Eguchi, 1968: C63, pl. C12 (figs 4–6).

New record

V-2635, 1 colony, IOM. Reference material: 3 syntypes of *B. fistula* from Siboga-105, ZMA Coel. 564.

Remarks

Like *D. cornucopia* Pourtalès, 1871, *D. fistula* is an unattached, recumbent corallum bearing numerous buds of variable length and position on the primary corallite, rarely, if ever, having an intact third generation. The specimen reported by Wells (1954) from the Marshall Islands differs in colony and costal shape and in having higher generation buds present.

Those species of *Dendrophyllia* having an unattached, recumbent corallum with irregular budding of smaller coralla from its theca (as opposed to attached, sympodially branching colonies more typical of *Dendrophyllia*) were placed in the new subgenus *Dendrophyllia* (*Alcockia*) by Eguchi (1968), but the name *Alcockia* is a junior homonym of a fish genus (Goode & Beane 1895) and thus will require a replacement name.

Distribution

Indian Ocean: off south-eastern Mozambique; off Zanzibar, Tanzania (Gardiner & Waugh 1939); Red Sea (Von Marenzeller 1907a, 1907b; Gardiner & Waugh 1939; Scheer & Pillai 1983); Maldiv Islands (Gardiner & Waugh 1939); 210–900 m. Elsewhere: Sulu Sea (Alcock 1902a, 1902c); 270–275 m.

Genus *Enallopsammia**Enallopsammia rostrata* (Portalès, 1878)

Amphihelia rostrata Pourtalès, 1878: 204, pl. 1 (figs 4–5).

Anisopsammia rostrata: von Marenzeller, 1904: 314–315, pl. 18 (fig. 23).

Madrepora ramea: Gardiner & Waugh, 1939: 226–227.

Dendrophyllia minuscula: Gardiner & Waugh, 1939: 237.

Non *Dendrophyllia amphelioides*: Gardiner & Waugh, 1939: 238.

Enallopsammia rostrata: Cairns, 1982: 57, pl. 18 (figs 1–4) [synonymy]; 1984: 27–28. Zibrowius & Gili, 1990: 39–42, pl. 6 (figs A–F), pl. 7 (figs A–F).

Enallopsammia amphelioides: Zibrowius, 1973: 45–48, figs 16–20 [synonymy]; 1980: 203–2 4, pl. 106 (figs D–I) [synonymy]. Zibrowius & Grygier, 1985: 131, 134, fig. 51.

New record

V-2731, 1 branch, IOM.

Distribution

Indian Ocean: off Comores Islands (Zibrowius 1982; Zibrowius & Grygier 1985); off Reunion (Zibrowius & Grygier 1985); Madagascar Plateau off Walters Shoal (Zibrowius 1982); off Maldive Islands (Gardiner & Waugh 1939); off Nicobar Islands (Von Marenzeller 1904); 229–805 m. Elsewhere: amphi-Atlantic, west and central Pacific, New Zealand region; 229–2 165 m (Cairns 1982).

Genus *Tubastraea**Tubastraea micrantha* (Ehrenberg, 1834)

Oculina micranthus Ehrenberg, 1834: 304.

Dendrophyllia nigrescens Dana, 1846: 387.

Coenopsammia viridis Milne Edwards & Haime, 1848b: 110.

Dendrophyllia micranthus: van der Horst, 1926: 43–44, pl. 2 (figs 6–7). Scheer & Pillai, 1974: 63, pl. 29 (fig. 3). Pillai & Scheer, 1976: 16.

Dendrophyllia cf. *micrantha*: Best *et al.*, 1980: 621.

Tubastraea micranthus: Macnae & Kalk, 1958: 123. Scheer & Pillai, 1983: 175–176, pl. 41 (figs 7–8) [synonymy]. Schuhmacher, 1984: 94–98, fig. 1a–b [synonymy]. Zibrowius & Grygier, 1985: 1039.

Tubastraea micrantha: Pichon, 1978: 441. Rosen, 1979: 20. Wells, 1983 [synonymy].

New records

Aldabra, 15 colonies, USNM 79137, 79138, 79140, 79143, 91832; Nossi Bé, Madagascar, 2 colonies, USNM 91833–34; Rodriques Island, 1 colony, USNM 22018.

Remarks

This species is easily distinguished from the five other valid species in the genus (*T. coccinea* Lesson, 1829; *T. diaphana* (Dana, 1846); *T. tagusensis* Wells, 1982; *T. floreana* Wells, 1982; and *T. faulkneri* Wells, 1982) by having arborescent, sympodially branched coralla, the others having phaceloid or plocoid colonies.

Distribution

Indian Ocean: off Mozambique (Macnae & Kalk 1958) to the Red Sea (Scheer & Pillai 1983); Comores Islands (Schuhmacher 1984); Seychelles (Milne Edwards & Haime 1848b; Best *et al.* 1980); off Madagascar (Pichon 1978); off Mauritius, Maldive and Nicobar islands (Scheer & Pillai 1974); 0,5–55 m. Elsewhere: western Pacific (Schuhmacher 1984).

Tubastraea coccinea Lesson, 1829

Tubastraea coccinea Lesson, 1829: 93. Wells, 1983: 243–244, pl. 18 (figs 1–2) [synonymy]. Cairns, 1991: 26–27, pl. 12 (figs c–e).

Lobophyllia aurea Quoy & Gaimard, 1833: 195, pl. 15 (figs 7–11).

Coenopsammia ehrenbergiana Milne Edwards & Haime, 1848b: 109, pl. 1 (fig. 12).

Non *Dendrophyllia coccinea*: van der Horst, 1926: 45 (= *Dendrophyllia* sp. cf. *D. horsti*).

Non *Dendrophyllia aurea*: van der Horst, 1926: 46–48 (= *T. faulkneri*).

Dendrophyllia aurea: Macnae & Kalk, 1958: 123.

Non *Tubastraea coccinea*: Scheer & Pillai, 1983: 175, pl. 41 (figs 5–6).

Tubastraea aurea: Pichon, 1964: 191; 1978: 441. Best *et al.*, 1980: 621. Scheer & Pillai, 1983: 173–174, pl. 40 (fig. 8) [synonymy]. Schuhmacher, 1984: 94–95.

?*Tubastraea* sp. Zibrowius & Grygier, 1985: 130.

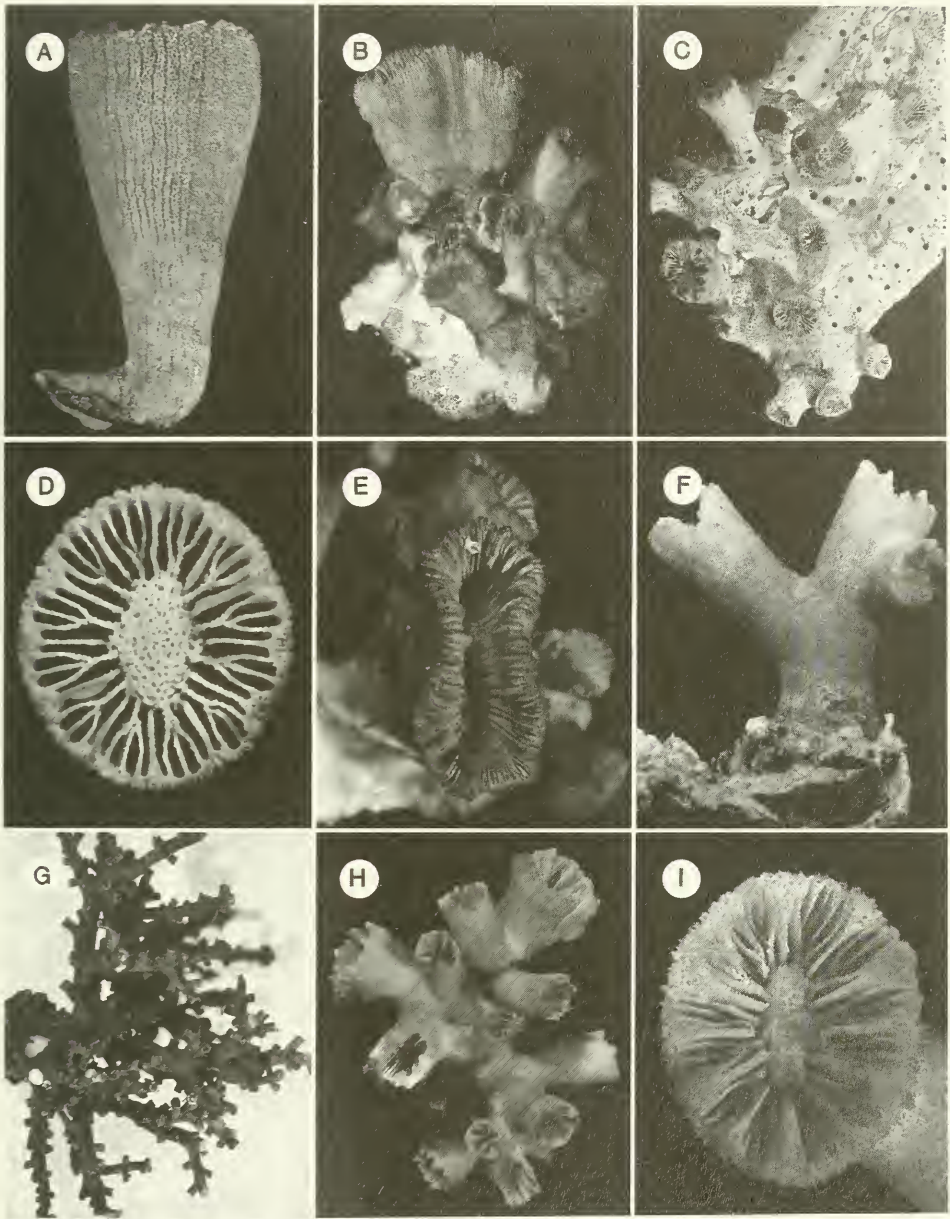


Fig. 13. A, D. *Balanophyllia diffusa*, Cr. 329-15, USNM 78594, lateral and calicular views. A $\times 2,7$, D $\times 3,6$. B, E. *Rhizopsammia compacta*, MN-ZA49 (USNM 91793) lateral view of a colony and calice of largest corallite. B $\times 1,1$, E $\times 1,8$. C. *Rhizopsammia annae*, AB-391J, USNM 91790, a small colony. $\times 1,4$. F, I. *Dendrophyllia* sp. cf. *D. horsti*, MN-ZC11, USNM 91819, lateral view of colony and calice of a corallite. F $\times 1,2$, I $\times 3,7$. G. *Dendrophyllia iijimai*, AB-394B, USNM 91844, colony with dried black tissue. $\times 0,25$. H. *Tubastraea diaphana*, Nossi Bé, Madagascar, USNM 91838, colony. $\times 0,8$.

New records

Aldabra, 0–2 m, 6 colonies, USNM 79139 and 79141; Nossi Bé, Madagascar, 2 colonies, USNM 91836–37.

Remarks

This species is distinguished from the other two species known from the Indian Ocean by having a plocoid corallum, not dendroid or bushy. *Tubastraea coccinea* was compared to the three eastern Pacific species by Cairns (1991, table 4).

Distribution

Indian Ocean: off south-eastern Mozambique (Macnae & Kalk 1958); Madagascar (Pichon 1974, 1978); Seychelles (Milne Edwards & Haime 1848b); Red Sea (Lesson 1829); Chagos Islands; Maldive Islands; Gulf of Manaar; Mergui Archipelago (Dana 1846); reef depth. Elsewhere: Pacific (Scheer & Pillai 1983); off Japan (Eguchi 1968); Galápagos and Cocos islands (Cairns 1991); western Atlantic (Cairns 1979); 1,5–110 m.

Tubastraea diaphana (Dana, 1846)

Fig. 13H

Dendrophyllia diaphana Dana, 1846: 389, pl. 27 (fig. 3).

Tubastraea diaphana: Scheer & Pillai, 1983: 174, pl. 41 (figs 1–4) [synonymy]. Wells, 1983: 243.

Tubastraea coccinea: Pillai & Scheer, 1976: 17. Scheer & Pillai, 1983: 175, pl. 41 (figs 5–6).

New records

Off Zanzibar, Tanzania, 1 colony, USNM 83697; Nossi Bé, Madagascar, 2 colonies, USNM 91838–39; southern coast of Natal, 9–15 m, 1 colony, USNM 91840.

Remarks

Similar to *T. coccinea* in septal arrangement, but colony forms small clumps or bushes with frequent budding from corallite walls instead of basal coenosteum.

Distribution

Indian Ocean: off Natal, South Africa; off Zanzibar, Tanzania; off north-western Madagascar; Red Sea (Scheer & Pillai 1983); shallow. Elsewhere: off Singapore (Dana 1846); central Pacific; Great Barrier Reef (Scheer & Pillai 1983); reef depths.

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APPENDIX
STATION LIST

Station number	Latitude (°S)	Longitude (°E)	Depth (m)	Date
<i>R. V. Anton Bruun (AB)</i>				
357B	29°11'	32°02'	69	30 July 1964
357E	29°10'	32°05'	168	30 July 1964
358A	29°19'	32°00'	366	30 July 1964
358C	29°21'	31°58'	366	30 July 1964
365C	23°19'	43°33'	439	12 August 1964
365D	23°20'	43°32'	475-695	12 August 1964
369J	24°12'	36°01'	1 140	17 August 1964
370D	24°28'	35°36'	880	18 August 1964
370G	24°20'	35°28'	347	18 August 1964
370H	24°41'	35°28'	311-320	18 August 1964
371E	24°46'	35°20'	132	18 August 1964
371F	24°46'	35°18'	110	18 August 1964
371G	24°49'	35°13'	73	18 August 1964
372B	24°48'	34°59'	42	19 August 1964
372G	24°53'	34°56'	55	19 August 1964
372J	25°07'	34°34'	106	19 August 1964
372L	25°07'	34°34'	112	19 August 1964
372P	25°57'	33°02'	37	22 August 1964
373B	26°00'	33°05'	135	22 August 1964
373H	26°58'	33°54'	896	22 August 1964
373J	26°58'	33°53'	880	22 August 1964
374D	27°08'	34°05'	1 326	23 August 1964
389C	30°12'	32°01'	1 360	7 September 1964
389E	30°09'	31°37'	930	7 September 1964
390S	29°35'	31°42'	138	9 September 1964
391H	29°21'	31°35'	57	9 September 1964
391J	29°21'	31°35'	57	9 September 1964
392J	29°19'	31°26'	38	10 September 1964
394B	29°27'	31°31'	68-70	25 September 1964
399A	22°33'	36°10'	925	1 October 1964
399B	22°30'	36°07'	850-960	1 October 1964
399C	21°18'	36°18'	1 510-1 600	2 October 1964
401B	19°50'	36°21'	65	4 October 1964
400C	20°30'	35°43'	62	3 October 1964
408D	16°42'	43°19'	150-300	15 October 1964
409E	16°11'	43°42'	62	18 October 1964
421A	02°54'	40°23'	34	7 November 1964
421G	02°56'	40°28'	240	8 November 1964
<i>R. V. Vityaz (V)</i>				
2608	12°28'	48°18'	780	14 November 1988
2626	24°42'	35°31'	320	22 November 1988
2629	25°28'	35°36'	1 250-1 520	23 November 1988
2631	25°30'	35°08'	490-535	23 November 1988
2634	25°05'	34°50'	90-92	25 November 1988
2635	25°05'	35°15'	110-230	25 November 1988
2637	25°13'	35°32'	980-1 000	26 November 1988
2644	22°19'	43°06'	330-335	2 December 1988
2650	22°22'	42°59'	950-960	3 December 1988
2653	22°17'	42°50'	1 440-1 510	3 December 1988
2662	22°14'	43°07'	310-315	4 December 1988
2668	33°01'	44°09'	1 010	8 December 1988

Station number	Latitude (°S)	Longitude (°E)	Depth (m)	Date
R. V. <i>Vityaz</i> (V) (cont.)				
2671	32°56'	45°01'	1 175	9 December 1988
2674	38°01'	45°27'	1 600-1 610	10 December 1988
2686	33°04'	43°52'	650-665	12 December 1988
2697	33°15'	43°55'	160	13 December 1988
2699	33°18'	43°54'	530-610	14 December 1988
2706	33°03'	44°33'	970-980	15 December 1988
2716	33°17'	44°55'	630-680	16 December 1988
2721	32°25'	43°37'	1 000-1 030	17 December 1988
2722	32°25'	43°37'	680-720	17 December 1988
2724	33°09'	43°50'	280-360	17 December 1988
2731	33°18'	44°08'	750-755	18 December 1988
2733	33°23'	44°06'	750-755	18 December 1988
2753	33°17'	43°52'	410-480	22 December 1988
2764	33°10'	43°41'	910-920	24 December 1988
2767	33°08'	45°49'	260	24 December 1988
2803	11°21'	61°44'	87-110	7 January 1989
2804	11°06'	62°14'	230-235	7 January 1989
2809	10°29'	61°09'	110-115	8 January 1989
2814	09°38'	60°50'	1 650-1 700	9 January 1989
2815	09°40'	60°30'	1 520-1 720	9 January 1989
2816	09°31'	59°55'	430-835	9 January 1989

R. V. *Meiring Naude* (MN)

SM-129	30°53,4'	30°31,7'	850	11 May 1977
SM-162	32°55,0'	28°31,0'	630	25 May 1978
SM-174	33°19,6'	27°52,4'	760	28 May 1978
SM-226	32°28,6'	28°58,8'	710-775	24 June 1979
SM-232	32°14,9'	29°10,4'	620-650	25 June 1979
XX-153	29°32,2'	31°19,8'	50	1 June 1990
ZA-43	26°54,0'	32°55,1'	43	3 June 1990
ZA-48	26°53,5'	32°55,6'	51	3 June 1990
ZA-49	26°54,3'	32°55,5'	45	3 June 1990
ZA-51	26°52,8'	32°56,0'	65	4 June 1990
ZB-11	27°00,2'	32°54,3'	68	5 June 1990
ZB-14	27°00,8'	32°54,3'	51	5 June 1990
ZB-17	27°00,3'	32°55,3'	67	6 June 1990
ZB-18	27°00,4'	32°55,2'	66	6 June 1990
ZB-20	27°01,1'	32°55,1'	69-73	6 June 1990
ZB-23	27°03,0'	32°54,7'	78	6 June 1990
ZB-24	27°03,6'	32°54,5'	70	6 June 1990
ZB-25	27°03,7'	32°53,4'	55	6 June 1990
ZB-27	27°03,9'	32°53,0'	44	6 June 1990
ZC-9	27°04,8'	32°53,5'	65	7 June 1990
ZC-10	27°06,0'	32°53,3'	74	7 June 1990
ZC-11	27°06,8'	32°52,9'	74	7 June 1990
ZD-4	27°11,1'	32°50,9'	100	7 June 1990
ZD-5	27°11,9'	32°50,2'	80	7 June 1990
ZD-6	27°13,0'	32°49,7'	72	7 June 1990
ZD-7	27°12,9'	32°49,7'	66-71	8 June 1990
ZD-8	27°13,1'	32°49,5'	60	8 June 1990
ZD-10	27°11,5'	32°50,4'	78	8 June 1990
ZH-18	27°31,8'	32°42,8'	70	2 June 1990
ZH-19	27°32,8'	32°42,8'	77	2 June 1990
ZH-23	27°33,8'	32°42,5'	64	2 June 1990
ZH-26	27°34,2'	32°42,1'	62-64	2 June 1990
ZH-27	27°35,6'	32°41,6'	62	2 June 1990

Station number	Latitude (°S)	Longitude (°E)	Depth (m)	Date
<i>R. V. Meiring Naude (MN) (cont.)</i>				
ZK-20	27°47,7'	32°34,0'	70-80	9 June 1990
ZK-21	27°47,6'	32°39,1'	62-84	9 June 1990
ZK-25	27°46,4'	32°39,4'	63-70	9 June 1990
ZL-3	27°54,3'	32°38,0'	105	9 June 1988
ZQ-8a	29°05,3'	32°08,3'	95	17 June 1989
ZU-13	29°31,8'	31°27,9'	110	19 June 1989
ZU-15	29°39,8'	31°30,1'	150	19 June 1989
ZV-5	29°44,3'	31°27,6'	300	20 June 1989
ZV-20	29°41,6'	31°21,0'	85	21 June 1989
ZV-21	29°41,4'	31°21,3'	85	21 June 1989
ZW-6	29°45,9'	31°17,6'	105	21 June 1989
ZW-8	29°45,9'	31°18,2'	105	21 June 1989
ZCC-1	27°08,3'	32°52,2'	98	7 June 1990
ZCC-2	27°09,9'	32°51,0'	150	7 June 1990
ZDD-2	27°14,6'	32°48,8'	74	7 June 1990
ZDD-3	27°13,5'	32°49,5'	74	8 June 1990
ZDD-4	27°13,6'	32°49,3'	75	8 June 1990
ZDD-5	27°13,5'	32°49,8'	78	8 June 1990
ZDD-7	27°13,9'	32°49,3'	66-82	8 June 1990
Miscellaneous stations				
<i>Vema</i>				
14-SAT6	29°48'	31°16'	232	23 April 1958
19-28	35°40'	21°59'	165	?
<i>Marion Dufresne (Cruise 27)</i>				
Sta. 4	08°29'N	79°19'	1 095	28 July 1981
<i>Sardinops</i>				
CD32	34°13,9'	18°29,3'	37	10 April 1971

EAMFRO (East African Marine Fisheries Research Organization, Zanzibar)

Station number	Locality	Latitude (°S)	Longitude (°E)	Depth (m)	Date
C13	north Kenya Banks	—	—	122	25 Feb 1971
Unknown vessel					
Cr. 329-10	off Zanzibar	—	—	183	11 August 1971
Cr. 329-15	off Zanzibar	—	—	273	11 August 1971
Cr. 333-14	—	02°40,5'	41°00,7'	223	9 December 1971
<i>Manihine</i>					
381-1		04°13'	39°41,5'	250	24 October 1974
381-3		05°27'	39°09'	302	24 October 1974
381-63		07°32'	39°52,6'	240	31 October 1974